JAN 5 1927

December 30, 1926

IN TWO SECTIONS
Section One

Engineering News-Record

Devoted to Civil Engineering and Contracting.

McGraw-Hill Publishing Company, Inc.

Studies and Works of a Missouri Drainage District, *by Jacob A. Harman*

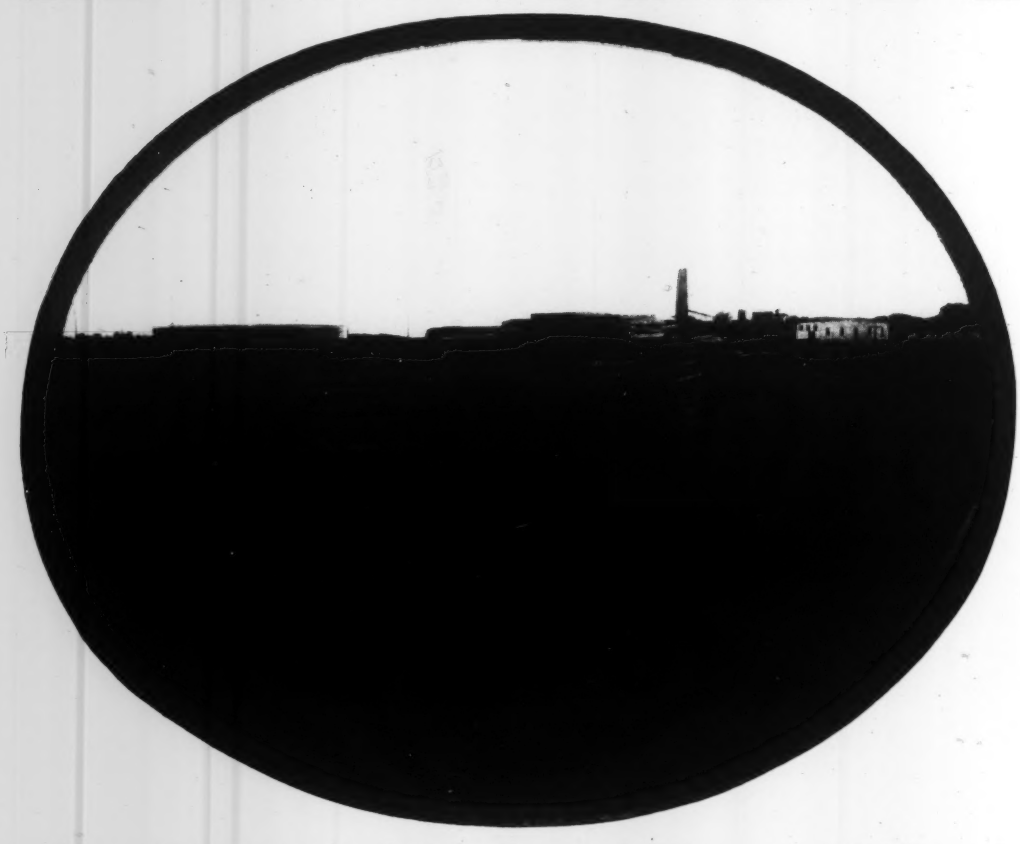
Applying the Principles of the Catenary to Roof Design, *by Martin M. Elizondo*

Construction and Plant Layout on the Martin Dam, *by L. G. Warren*

Relation of Zoning Ordinance to House Widths *by Arthur Richards*

Martin Dam on the Tallapoosa in Alabama

KREOLITE



Kreolite Industrial Railroad Ties and Timbers

A Kreolite Railroad Cross Tie will last at least 20 years or three or four times as long as the untreated tie.

500,000 ties, and millions of feet of switch ties, structural timbers and piling, in all sizes, of SOLID oak or pine are always in our yards properly sticked for air-seasoning before treatment.

We specialize in framing timbers to your plan before treatment.

Quick shipment on short notice.

Write for detailed specifications and information.

THE JENNISON-WRIGHT COMPANY, TOLEDO, O.

Branches in All Large Cities

WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 97 NEW YORK, DECEMBER 30, 1926 Number 27

Straws in the Wind

SOME things seem to indicate that Congress, or at least the present Congress, is beginning to be irked at economy in federal expenditure and especially at the executive method of enforcing that economy. The executive, through the War Department, recommended certain definite river and harbor appropriations, but the Senate committee would not be restricted to the program set. The executive, through the Interior Department, has a certain program of reclamation expenditure but it is not great enough to satisfy a large and powerful congressional group which threatens to step beyond the recommended bounds. The executive, through the Director of the Budget, set certain limits to naval construction, but Congress is pulling at the traces and bids fair to go its own way in building ships and rather to listen to the Navy itself, which by training and tradition never has enough ships. It is an interesting situation. Has Congress been stampeded by the large surplus the nation continues to pile up and sees in it a chance to return to the pork-barrel days, when each congressman satisfied the selfish demands of his own constituency by trading with every other selfish desire? Or has the legislative branch begun to resent the too great inroads of the executive into the constitutional prerogative of Congress to order the procurement and expenditure of funds? So far only straws are blowing in the wind. It will be interesting to watch how far they bend.

Chicago Road Show

IMPRESSIVE figures of the volume and value of road building equipment being assembled at Chicago for the exhibition of the Highway Industries Association, which will be held during the second week of January in connection with the convention of the American Road Builders Association, directs attention again to one of the most notable expositions of the many which American industries offer annually for the service of their patrons. The Chicago "Road Show," as it has come to be known, has few counterparts among exhibitions. It is not alone an elaborate display of the machines and materials of an industry; it is a critical summary by technicians of the problems and practices of that industry. Its work is a collaboration of the three elements of industry: the engineer designer and director; the contractor builder, and the manufacturer purveyor of machines and materials for construction. All are represented at the Chicago "Road Show," each has a definite and distinctive part in the exhibition and convention proceedings and activities, neither is a subsidiary of the other, there is a federation of finances, direction and business management. From this has developed a unique organization giving an unusual service, known legally and officially under several titles but to the generality of its fifty thousand visitors as the 'Chicago Road Show." Naturally, it requires a huge expenditure of funds but its justification lies in its popularity.

Short Traffic Intervals

NEW YORK CITY has just issued a new set of traffic regulations to go into effect the first of the year. They are complete and instructive, provided the driver is able to comprehend all of their complications as to the technique of turning at corners under the varying conditions of traffic that can arise. They contain also an innovation which too often will turn out merely to be a pleasant gesture, that is the granting of the pedestrian the right of way over the vehicle at crossings. They show no sign, however, of a recognition of what is the crowning fault of New York's traffic control, just as it is of the control of many of our smaller, but equally congested, cities. So far as the new rules show the metropolitan traffic police will continue to allow too long intervals between shifts of cross traffic. This error is so frequent and the cure so obvious that it is a mystery why so many directors of traffic control persist in continuing it. Chicago and Los Angeles have learned that the quick shift of lights accelerates traffic by reducing the total length of the stop intervals any vehicle has to endure in getting from one point in the city to another. New York continues to view the condition from the eye of the individual traffic officer, who seeing a long line of vehicles on one of the streets feels that all traffic will be expedited by getting that one line past his post as soon as possible. He does not visualize the cross streams held up by such procedure, not only once but, where long blocks exist, two or three times between crossings.

Action Needed

THE fact that the Detroit collector of internal revenue has been trying to make the publicly owned water-works there pay a corporate income tax should impel water-works men to act more vigorously than they have yet done to remove the injustice that they suffer by reason of having to pay income tax on their municipal salaries while thousands of other city employees are exempt. The same is true of men and women on the payrolls of other utilities besides water-works. Congress has granted relief from income taxes back of 1925, which the Internal Revenue Bureau suddenly began to demand two or three years ago, retroactive for some years. The comparatively recent decision in the Detroit municipal street railway employees' case held those employees exempt on the ground that they were engaged in a governmental function. This was no aid to water-works men because the courts have long held that water-works are non-governmental. The Detroit decision was that of a lower court. The government appealed from it

but withdrew the appeal on the passage of the Internal Revenue Act of 1926, since the case related to back taxes only, voided by the act. Until a case is carried to the U. S. Supreme Court, or until Congress gives relief, all employees of municipally owned utilities will be called on to pay income taxes on their salaries earned from the year 1925 on, but employees in sewer, fire and police departments will continue to go free. Action is needed to bring the issue squarely before both the U. S. Supreme Court and Congress.

Credit to the Subordinate

THERE is a good deal to be said in favor of what Mr. Keator says in his letter on another page suggesting that the overhead engineer give full credit for what his subordinates have done. It is not a common fault of engineers to thus neglect their associates. More often than not the editorial revision of an article submitted to this journal requires the elimination, for the sake of brevity and balance, of a number of subordinate names which the superior in all generosity and thankfulness has included in his list of responsible personnel. But once in a while the opposite occurs. Only a short time ago one of our leading articles was strangely deficient of names because its author, the head of a large engineering organization, insisted that only that organization be named as the responsible director of the design and the construction of the work. Many excellent engineers and construction men were connected with that work; some of them really added a definite personal contribution to its successful completion and deserved to be noted in any account of its development. But the titular head of the organization believed, as many men in such position believe, that this was an organization, not a personal, triumph and as such anonymity must be the individual's portion. It is difficult to lay down a rule to govern such cases, to say just how far down the line public credit should be given to individuals, but every directing engineer may well inquire of himself when the time comes whether he should not pay public testimony to those who have helped him to produce that for which he, as chief, gets the major credit.

Mongrel Plan Defeated

DEFEAT of the mongrel type of council-manager charter at Seattle at the last election, combined with the results at an election last March, may be taken to mean that the people of that city want at least a nearer approach to the standard manager plan or none at all. Nine months ago a charter amendment that would merely have added a city manager, lacked only 111 votes of being adopted, while there was a majority of 4,700 for a charter revision commission. The speedily-drawn mongrel type of council-manager charter. The engineering organization plan proposed under the defeated charter was excellent. It would have been under the proposed "business manager" who would have been freed of the duty of police management, "the rock on which many a city manager has been wrecked," and it would have been interesting to see how a manager whose chief responsibilities had to do with public works would have got along. Doubtful features of the proposed charter were not only a police board but also various other boards, in place of single-head departments, and councilmen elected to represent wards instead of the city as a whole.

Welcome Instruction

THAT local engineering societies may serve as a means of direct instruction as well as means of general information and social gathering, and that such service may be welcomed by their members, is indicated by the recent action of the Milwaukee and Detroit societies in arranging for courses of lectures on engineering economics and strength of materials respectively. In each case the plan was worked out with the co-operation of the state university and in each case a gratifying number of engineers was ready and willing to pay the fees charged for defraying necessary incidental expenses. Such definite courses of lectures are in a class distinct from the general or miscellaneous range of papers presented at the regular meetings of such local associations.

Express Highways and Tolls

HISTORY and tradition so govern our thinking about many things that we frequently fail to remember that times change and that we must change with them. Most of those who direct our highway policies are in this condition of mind when it comes to thinking about toll roads. They remember the history of such roads. They recall that though they once existed, with a growing facility of transportation it was recognized that the prosperity of a community depended on free communication and that it was contrary to public policy to permit private ownership either to tax travel or to prevent or incommode transportation. Consequently, the community agreed to accept common responsibility for the construction and operation of all highways, which should be free to all. Because for a generation this has been undisputed too many of us have come to believe that it is one of the fundamentals of our free institutions and have neglected to observe that some things in transportation have changed in this same generation. These changes make it quite possible to justify toll roads under certain conditions.

It may have been forgotten that the day of the early toll road was the day of commercial road transport. Few people traveled over roads in their own vehicles, except for limited local communication. Both passenger and freight paid his or its own way to those who operated means of transport. Then came the canals and the railways and long distance highway transport stopped and with it stopped most of the justification for the toll road. Long-distance travel by individual vehicles—the bicycle and then the automobile—came later but then the use became so universal that the demand for the free road was made obvious, for to make a man traveling of his own free will and in his own vehicle pay tribute to some private owner of a road was obviously restrictive of the individual liberty we prize. The toll road had to go.

There has come a great change in road travel in the past half decade. Our roads now are cluttered up not only with the vehicles of the individual, but with vehicles of hire—buses carrying dozens of paying passengers and trucks carrying tons of freight, and every passenger and every ton are paying toll to the carrier, who in his turn is riding on this community road, if not free, at least at a much smaller proportionate cost of the profits he makes and the damage he causes than does the individual.

To a degree it is easier to charge this carrier by some other means than tolls for the use that he enjoys. His licenses and his taxes are sufficient in most cases to pay for what he uses, but there can be a limit to the amount of road the community can afford to provide for this commercial traffic. It may be that the community that provides the road does not benefit by the traffic that it carries either by a hypothetical lowering of retail prices due to lower cost of transport or by the convenience of passenger travel afforded, and yet the road may be so congested by this foreign traffic that it becomes impassable or inconvenient for the individual user and paralleling facilities are demanded. It is just at this point that the toll road ceases to be the impossibility it has been assumed to be for at least 50 years, and the number of places where such conditions exist and where toll roads are not only economic but political possibilities are many.

Such roads have justification not to penalize or to obstruct one kind of traffic but to make more and better road facilities possible by a construction tax on that traffic that prefers express service at cost. Under conditions today it is neither a public obligation nor a financial possibility to provide free express highway service. Why should we not take advantage of the fact that there are those who want such service, and are willing to pay directly for it, and by so paying contribute sufficient funds so that in not too long a time the facility will be paid for and may revert to the state for free service.

It might be laid down as a principle that a toll road is practicable wherever it would pay and wherever there is a free paralleling route. If there are enough people driving their own cars or running vehicles for hire who are willing to pay for the privilege of running these vehicles over a private right-of-way, it is to be assumed that that toll road answers a public demand. Whether a toll road should be built wherever it is practicable is another matter, but it is a fact that many communities have reached the limit of their financial capacity to build roads, that the average motorist will not benefit by the construction of special service roads and that the general elevation of taxation or motor licenses to pay for such roads would be unfair to most of those on whom this burden would fall. With proper provisions for refunding, so that the people would in due time get back the road for full use, the toll road offers the only solution to some traffic problems.

There are certain routes in this country that demand just such a road. Whether they shall be private or public toll roads is not in question, for it may be difficult to persuade private capital that there is money to be earned in such a venture, but the kind of traffic that would be carried on these potential routes is the kind that should pay for its own privilege regardless of whatever other licenses or taxes it is already paying. Take, for instance, the proposed new road to carry the traffic from the Holland tunnel west to Elizabeth, a wide, solid highway, with bridges and tunnels to insure no grade crossings, which will permit vehicles to go at high speed beyond the interfering heavy traffic of Jersey City and Newark. That road is estimated to cost over $20,000,000 for around 12 miles, probably the most expensive highway in the world, and it is, as at present designed, to be paid for by the State of New Jersey. Why? Because it is in the State of New Jersey. But the citizens of the State of New Jersey benefit but very little by such a highway. It is a main thoroughfare, a connecting road, through which the freight and passenger traffic from the south will pass into and beyond Manhattan Island. It will unquestionably be crowded with Philadelphia-New York travel; and yet the State of New Jersey is to pay for it. Those living alongside of this road will get some benefit from it, but they constitute only a part of the citizens of the state. If ever there were a place where a toll road was justified, this is the location. Let those who will benefit from such a road pay for it. The rest of the travelers in this vicinity have plenty of adjacent paralleling roads that they can use.

This is only one of the places where a toll road might be justified. There are other places—Chicago to Milwaukee, Boston to New York, Washington to Baltimore, Atlanta to Birmingham, Portland to Seattle, San Francisco to Los Angeles—all of these nearby cities now or in the not too distant future might well be tied up by a through road, free of grade crossings, open to a fair speed, and paid for by those who use them. The toll road is by no means an impossibility and our road authorities and our legislators should open their minds to the changed conditions that may justify it.

Free Professional Service

CHANGING conditions in the business relations of engineers have of late borne in heavily on established professional principles, and many a troublesome problem has been put to the practicing engineer thereby. The selection of consulting and designing engineers on the part of cities or counties by a method of competitive hearings, or even competitive bidding as to fees, will be recognized as a leading instance. A somewhat different phase of the situation presents itself in the action of the city of Buffalo, reported in this issue. The city engineer has invited various consulting engineers to prepare and submit preliminary designs for several bascule bridges, from which he intends to select a preferred design. There is no consideration, no *quid pro quo*, unless it be in the shape of patent royalties in case the author of the design selected has patented some essential part of his structure. The case brings up a number of obvious professional questions, and in publishing the invitation and statement we do so with the conviction that engineers generally will want to give these questions careful thought. If private engineering practice is to survive, if it is to remain on a sound basis where the indispensable professional and business relationships of engineer and client receive full recognition, it is time to begin seriously on the task of dealing with the practical problems that arise.

Another aspect of the Buffalo case calls for thought at the same time. This is a question of sound public policy; is it compatible with the best interest of the public served to depend upon gratuitous service, or does the old rule apply, that a curbstone opinion is worth only what it costs, that is to say nothing? In essence this point is involved in the other one, the purely professional aspect; but a more adequate view of the case may result if the facts are viewed separately from the standpoint of the engineer and from that of the citizenry for whom the free service is asked.

Construction Methods and Plant at Martin Dam, Alabama

Elaborate Derrick Plant Served by Job Railway Handled Excavation, Concrete and Forms—Sawmill and Crushing Plant Important Adjuncts—Camp Layout Notable

By L. G. Warren
Assistant Superintendent in Charge of Engineering,
Dixie Construction Co., Dadeville, Ala.

CONSTRUCTION methods as well as the permanent structures make the Martin dam and power house at Cherokee Bluffs, a storage power project on the Tallapoosa River about 42 miles north of Montgomery, Ala., one of the most notable construction operations in the hydro-electric field. The Tallapoosa River has a recorded variation of flow from 350 to 119,000 sec.-ft.

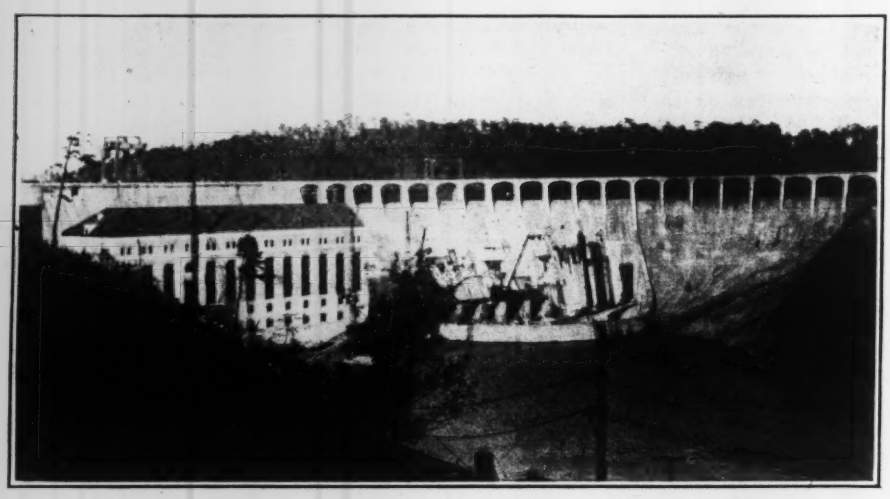


FIG. 1—COMPLETED DAM AND POWER HOUSE
Gantry cranes for intake gates and crest gates on top of dam. Slope of empty sand bin in left foreground, concrete mixing plant beyond, and construction bridge (being removed when picture was taken) extending out past the power house.

Large storage is therefore an essential of power development. The new dam and power house (head wall type) form a reservoir 39,400 acres in area at El. 490 and having a capacity of 1,376,000 acre-ft. for a drawdown of 60 ft. The shore line at El. 490 is 750 miles.

All the main elements of the permanent structures are shown by the general plan Fig. 2 and the sections Figs. 3 to 5. The more impressive features are: the great size of the three generating units; height of dam; attractive design and magnitude of power house; arches for bridge on spillway; great size of substation yard; unusual extent and heavy slope of concrete apron below the spillway; and the novel feature of the entire layout is the auxiliary dam, constructed downstream from the main dam. This dam forms a pool, or cushion of water 22.5 ft. deep, to receive the flow over that portion of the spillway which will be used normally.

Construction Features—The outstanding features of the construction were: all plant and equipment electrically driven, except two steam shovels, two locomotive cranes, and locomotives; handling excavated material, placing concrete and moving forms, successfully carried on by steel guy derricks; side hill storage bins of great capacity for sand and gravel; and method and rapid progress of concreting stream control openings in spillway, during final closure.

Access and Housing—Access to the work for materials and equipment and provisions for housing and feeding a large force of mixed colored and white laborers were a major problem. The work was 6 miles from the Birmingham & Southeastern R.R. at Asberry, Ala. There was highway connection to Asberry and for preliminary hauling this road was used. A railway connection was necessary and it was begun first of all work in June, 1923, and completed in February, 1924, developing into a considerable system of main-line and yard tracks. It will, therefore, be described in some detail as will be the camp facilities which were exceptionally fully developed.

To complete the main line railroad, between Asberry, Ala., and the project, it was necessary to grade for 6 miles of track, requiring 30,020 cu.yd. of rock and 74,224 cu.yd. of earth excavation. Seven trestles, having a total length of 1,247 ft., and an average height of 50 ft. and a maximum height of 60 ft. were built. The track was ballasted in only a few short sections. The maximum grade was 3 per cent and the maximum curvature was 18 deg. To secure a main line crossing, at the lower limits of the job, a long bridge of 13 spans was constructed of steel girders, supported on concrete piers. The total length was 624.5 ft.; maximum span 76 ft.; maximum height of piers 24 ft. This structure required 775 cu.yd. of concrete, 173 tons of structural steel and 49.3 M. ft. b.m. of timber. It also formed the connecting link between the yard and plant tracks on the east and west shores of the river. Rails weighing 65 lb. per yd. were used. After the completion of the project, the main line railroad will be removed.

The yard and plant tracks were divided into three divisions; east shore, west shore and high line. Connecting the east and west shore divisions at the upstream end of the yard, another bridge was constructed, carrying a double track, standard gage. This bridge was 600 ft. long and consisted of steel girders resting on concrete piers, Fig. 6. The piers started on the west shore in the tailrace and followed a curved alignment across the channel at the toe of the dam. They were founded upon the apron of the dam for approximately 50 per cent of the length of the bridge. This bridge was also known as the "construction bridge" and it formed the main feeder for concrete cars to the derricks and the main outlet for rock-loaded cars from the ex-

cavation. The derricks were placed so that they could reach both tracks on this bridge. The main line river bridge formed a connecting link between the east and west shore divisions at the downstream end of the west shore division. Downstream from the main line river bridge, the east shore lines were extended for approximately 3,700 ft. and a ladder track system was built to secure access to the permanent equipment storage yard, car repair shop, etc. The reinforcing steel yard, the ice storage house, etc., were also located in that vicinity.

The high-line railroad was built expressly for handling concrete materials from the main line railroad to the sand and gravel storage bins and the cement warehouse, Fig. 11. The maximum grade was 3 per cent. At its upstream terminus, at the sand and gravel bins, the track was carried on a timber trestle 375 ft. long with a maximum height of 60 ft. and an average height of 40 ft. From the dumping trestle the loaded cars of sand and gravel and crushed stone were dumped directly into the storage bins. At the downstream limit of this trestle, a branch line was carried to the cement warehouse. There, cars of cement were unloaded directly into the building. Chutes were carried through the building from the unloading platform of the cars to the charging floor of the mixing plant. These chutes also were so arranged that cement could be transferred from the cement warehouse into them for delivery to the mixing plant.

Due to the isolated location of the project, it was necessary to build a camp which afforded most of the conveniences of a small city. It covered an area of 117 acres and had a total of 311 buildings. The following service buildings were erected: Community hall (36 x 66 ft.) in which the church services, moving pictures and staff meetings were held; a school for white children, consisting of two rooms, and affording facilities for 60 children; a pool room equipped with five pool tables and also with a soft drink and confectionery stand; a barber shop annex, equipped with two chairs, to the pool room; and a commissary, or mercantile store (72 x 30 ft.) containing a meat shop, grocery department and dry goods section.

In the negro section of the camp, a dance hall (30 x 50 ft.) was constructed. This dance hall was very popular with the negroes and was one of the factors in keeping this class of labor satisfied. In addition, a pool room (30 x 50 ft.) was erected and equipped with three pool tables and also a soft drink and confectionery stand. A combination church and school for negroes, having a seating capacity for 50 people, was erected. The company mess hall could feed 200 whites and 160 negroes simultaneously. The company provided an electrically equipped bakery, having a capacity of 400 small and 400 large loaves per 24 hours.

A very complete hospital was constructed and operated. One end of the building was divided into a very large glassed-in sleeping porch, and also a large ward room, both being assigned to white patients. The other end of the building was divided similarly and assigned to negro patients. Each ward had a capacity of twelve beds. A completely equipped operating room was on the main floor in the center of the building. In the basement a bacteriological laboratory and a dark room for developing X-ray pictures and the kitchen and heating plant, were situated. The X-ray machine was located in a separate room on the main floor. Two doctors and several nurses were on duty regularly at the hospital, during all hours of the work. The hospital was operated under the direct supervision of the chief doctor at the job. This doctor reported directly to the chief surgeon of the Alabama Power Co., at its Birmingham headquarters.

For water supply, raw water was taken from the Tallapoosa River and pumped by two electric-driven 70-g.p.m. triplex pumps to the coagulation tanks of the filtration plant. There, the raw water was first coagulated and then settled for six hours, then passed through a combination sand and gravel filter, gravity type. From the filters, the water flowed to a clear water well. It was pumped from that well to two storage tanks, each having capacity of 20,000 gal. Between the clear water well and the storage tanks, the water was treated with chlorine during the pumping process. From the storage tanks, the water was fed through a 4-in. main to the camp by gravity. No typhoid fever cases have developed in the camp, which shows splendid operating results at the water plant.

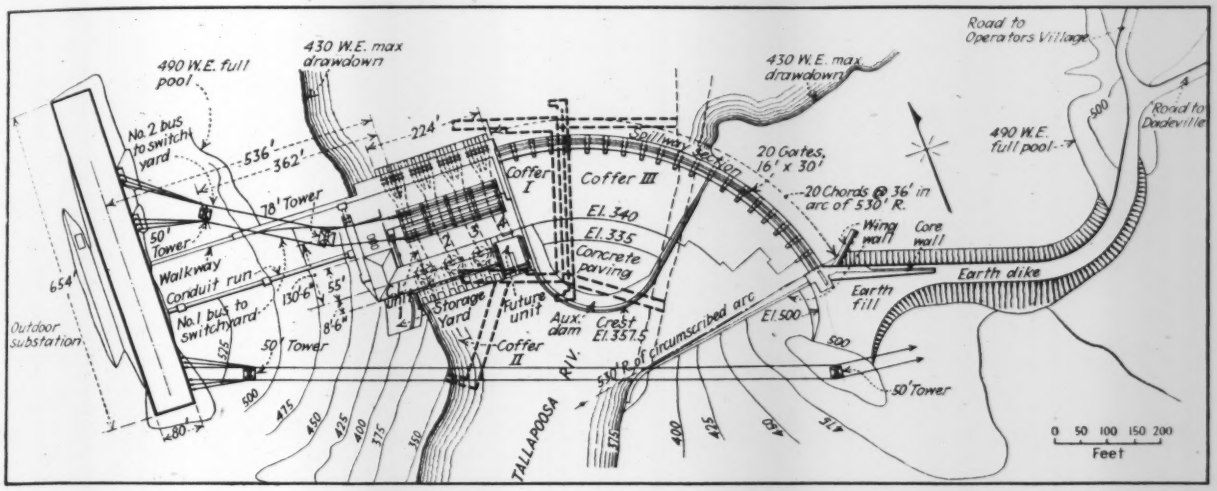


FIG. 2—GENERAL PLAN OF HYDRO-ELECTRIC POWER DEVELOPMENT AT CHEROKEE BLUFFS

An adequate system of sewers drained the upper section and central area of the camp. The main outfall of this sewerage system terminated in a combination septic tank and aeration chamber. Satisfactory results were secured in the operation of this sewage treatment plant.

Excavation and Grouting—Investigation of the foundations was made by 28 diamond drill holes aggregating 1,048 ft. Hard micaceous schist, streaked with shallow layers of quartz, etc., formed the foundation for the main structures of the project. The corewall of the dike was carried down to firm rock, penetrating below two widely separated clay seams. Very heavy excavation was required in the east bank to reach satisfactory rock deposits.

For the spillway section, west of Pier 13, Fig. 2, and for all structures west of Pier 1, the drilling was done with jackhammers, all using compressed air. For the heavy excavation in the east bank, four well drills were employed to penetrate to elevations near to the proposed final grades. A total of 109 well drill holes, with a total penetration of 4,502 ft., were drilled. The maximum depths of the holes were 65 ft., and the average depth was 40.1 ft. These holes were arranged in parallel lines. Quarry gelatin, 4x10 in., and cordeau and detonators were used as explosives in the well drill holes. Satisfactory results were secured with this blasting. After the main body of the excavation was removed by steam shovels, the air drills were placed in service.

On a line 6 ft. downstream from the upstream face of the spillway of the headworks and of the retaining section, and spaced 4 ft. apart, 2-in. diameter holes were drilled to a 20-ft. penetration, into the rock foundation. Iron pipe was then screwed into nipples in these holes. These pipes were filled with water, which placed the bottom of the drill hole under a total hydrostatic head of 40 ft. Careful and frequent observations were made upon the water heights in the pipes. If excessive leakage was shown, the hole was grouted to refusal.

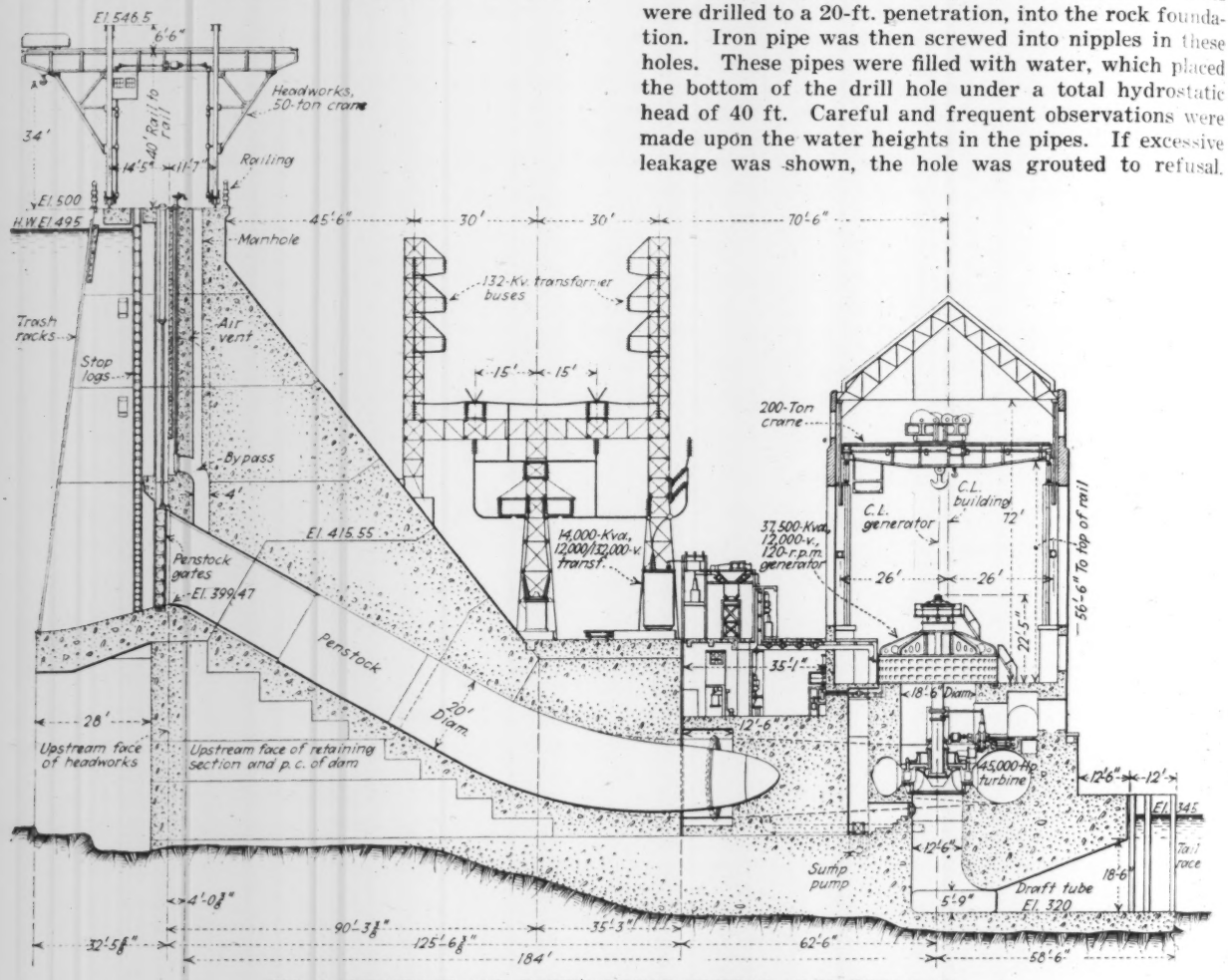


FIG. 3—PENSTOCK AND POWER HOUSE SECTION AT MARTIN DAM

A second hole was then drilled 6 ft. downstream from the first hole. If the second hole, under a similar water test, gave excessive leakage, it was grouted to refusal, and a third hole was drilled 6 ft. downstream from the second hole. A water test was made on the third hole, also. This hole was connected with pipe which led to the downstream face of the structure. If the first or second holes showed satisfactory results under test, they were connected in a series of four holes to a manifold. The manifold was then connected to a pipe leading to the downstream face of the structure. Very few holes showed excessive leakage, requiring grouting. A total of 240 bags of portland cement was placed as grout in these holes.

Stream Control—The cofferdam layout was divided into three sections, built in sequence. No. I cofferdam, Fig. 2, formed a barrier across the channel of the river in a maximum depth of water of 29 ft. It enclosed an area of 278x176 ft., or 1.12 acres. As the plan shows,

this coffer enclosed the power house, headworks and the spillway from the east face of the headworks to pier 4. Very little trouble was experienced in dewatering and maintaining a dry condition. Round logs were used and drifted together with ¾x20-in. steel dowels. Coffer II, Fig. 2, joined the downstream arm of coffer I, and included the tail race and extremities of the draft tubes. It confined an area of 0.206 acres, having a length of 200 ft. The long arm crossed the deep channel diagonally. This arm was founded upon a sloping ledge of rock, dipping toward the deep channel. The

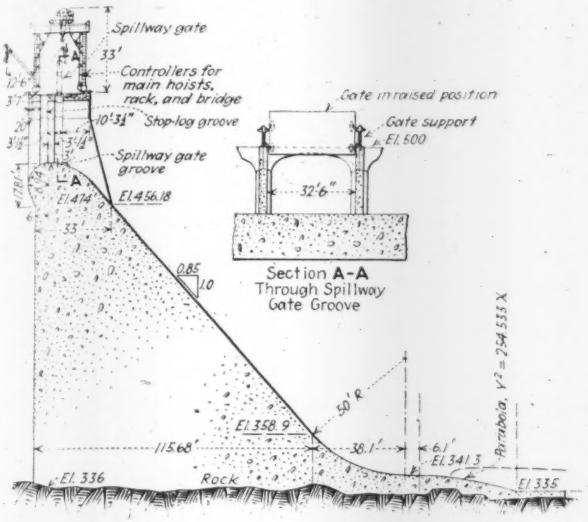


FIG. 4—TYPICAL SECTION OF SPILLWAY AT PIER 10

maximum depth of water at this coffer was 38 ft. Construction was started Nov. 8, 1923, and was finished Oct. 23, 1924. Difficulties were encountered in dewatering this coffer area and maintaining it. Heavy leakage occurred through fissures in the rock foundation under the long arm. One slide or movement of the long arm resulted in the loss of 60 ft. of the arm. This movement was due to the slope of the rock foundation. After rebuilding this section and dewatering had been accomplished, a second sliding movement of the long arm occurred. However, the dumping of several thousand yards of rock spoil on the outside stopped the movement.

Cofferdam III, Fig. 2, crossed the shallow section of the river. It was constructed after unit 4 headworks and spillway stream control openings 1 and 2 had been concreted to sufficient height to carry the summer flow of the river. The top elevation of the upstream arm of this coffer was at El. 365. The downstream arm had a top elevation of 350. This coffer enclosed an area of 0.88 acres, being 208 ft. long and 184 ft. wide. Construction was started March 21, 1925, and finished April 23, 1925. Dewatering was quickly accomplished and easily maintained. The weather conditions were ideal for this phase of the operations.

Stream control was based upon six openings: One in unit 4 headworks, having a clear span of 27 ft., and five in the spillway section, each having a clear span of 30 ft. at the upstream end. The concrete foundations of these openings were poured to elevations shown in Fig. 8. Unit 4 headworks was concreted to El. 460, before starting to pour additional concrete in the stream control openings. The 20-ft. diameter penstock in unit 4 will serve as a stream control opening, during the operation of the project, after construction is finished and until unit 4 turbine is installed. The remainder of the concrete in the spillway openings was poured in 10-ft. stages, alternating in elevation heights. Three portable closure caissons were built to serve both as water barriers and forms for the upstream face. This closure procedure as diagramed in Fig. 8 was very satisfactory.

Materials Production—One of the original adjuncts, planned for the project, was a stone quarry on the west shore of the river, downstream from the dam site. The rock was quartzite. Primary drilling was with four motor-driven well drills. A 6¾-in. bit was used. Secondary drilling was with jackhammer drills. In the well drill holes, 4x10-in. quarry gelatin and cordeau were employed. Fifteen major blast were fired at the quarry, moving a total of 105,730 cu.yd. of rock; 39,517 lb. of quarry gelatin were shot to secure this yardage, averaging 2.56 cu.yd. per pound of explosive. A total of 148 well drill holes, totaling 6,020.5 ft. of penetration, were driven. This penetration averaged 20.8 cu.yd. of rock moved per foot drilled.

The blasted material was loaded into steel skips, on standard-gage flat-cars by a 70-C shovel. The loaded

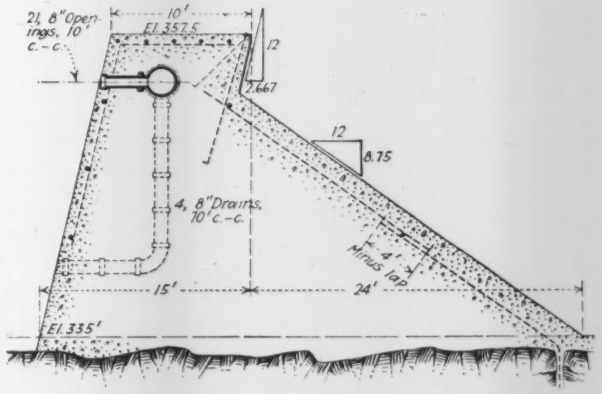


FIG. 5—SECTION OF AUXILIARY DAM BELOW THE SPILLWAY

skip cars were then hauled by steam locomotive to the 60x48-in. jaw crusher, adjacent to the quarry. There, a 60-ft. boom wood derrick hoisted the loaded skips to the crusher hopper for dumping. A locomotive crane loaded large plumstones on flat-cars for transfer to the dam, to be placed in mass concrete. Early in the operation of the quarry, three 20-ton capacity steel derricks were in operation to store plumstone. This phase of the quarry operation preceded the erection and operation of the crushing plant. The quarry produced 14,566 cu.yd. of plumstone, and 55,410 cu.yd. of rock were delivered to the crushing plant up to June 1, 1926.

All crusher equipment was motor driven. It included one 60x48-in. jaw crusher, one No. 5 gyratory crusher, and one No. 6 gyratory crusher. The material movement was as follows: From jaw crusher to a 42-in. belt, thence through the 72-in. x 17-ft. screen. This screen permitted the 1½-in. rock to pass to the small-rock bin in the crusher plant building; the 6-in. stone to pass to the cobble-stone bin in the crusher plant building; and the oversize stone to pass to the secondary or gyratory crusher. The bucket elevator carried the

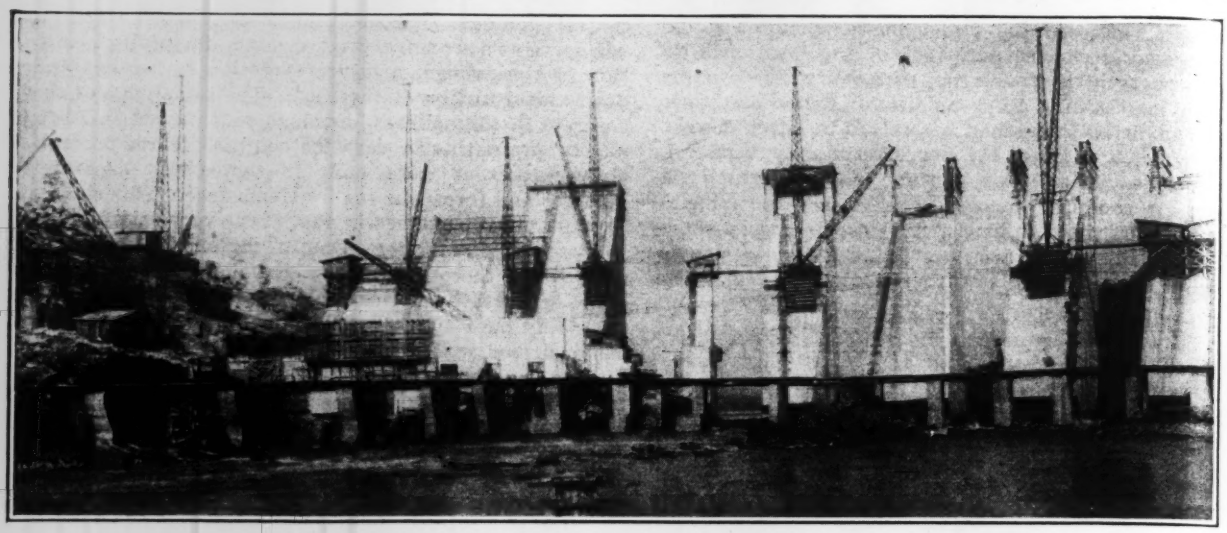


FIG. 6—CONSTRUCTION BRIDGE AND DERRICK ARRANGEMENT

gyratory crusher product to the small-stone bin in the crusher building. From this bin, the small stone flowed through a gate-controlled chute to standard-gage railroad hopper cars. The rock filled hopper cars were hauled to the gravel storage bin and dumped. From the cobble-stone bin, in the crusher building, the cobbles flowed through a gate-controlled chute to 5-cu.yd.

FIG. 7—AUXILIARY DAM BELOW SPILLWAY
This dam is designed to destroy the energy of the water flowing over the portion of the spillway that will be used for all but very abnormal floods. Piers at the toe of the main spillway have been removed.

capacity, side-dump, narrow-gage cars. The cobble-loaded cars were then hauled by steam locomotive to the 500-cu.yd. cobble-stone storage bin, Fig. 10, and dumped.

Nearly all of the lumber consumed at the project, 79 per cent, was furnished from lumber mills operated by the construction company forces on Alabama Power Co. property in the reservoir basin. These mills were operated under an experienced lumberman, who reported to the construction superintendent. A total of 10,623 M.ft.b.m. was produced up to May, 1926. The lumber was hauled by teams and Ford trucks to the storage yards at the project. All planning and surfacing was done at the project shops. In addition to the low cost of lumber, the advantage of securing large and all sizes of timber, at almost any time, is another desirable result of the company's operating its own mills.

The portion of the reservoir site between the 430 and the 490 contours, 33,800 acres, was cleared of all brush and timber; and all trees which would project above the line of maximum drawndown were cut. This produced 18 M.ft.b.m. of merchantable timber, most of which was used as noted above. Local labor from nearby farms was used as much as possible in this work, the company co-operating with the farmers in using their labor between crop seasons.

In order to comply with the state law concerning the control of malarial mosquitoes, a sanitary corps was organized to carry on the exterminating work in the

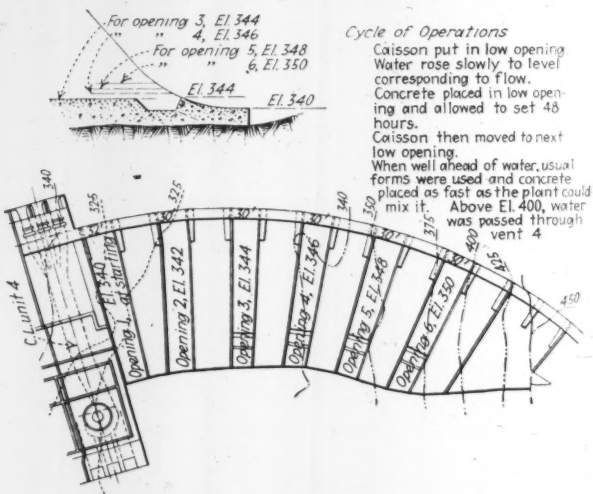

For opening 3, El. 344
" " 4, El. 346
For opening 5, El. 348
" " 6, El. 350
El. 344
El. 340
Cycle of Operations
Caisson put in low opening
Water rose slowly to level corresponding to flow.
Concrete placed in low opening and allowed to set 48 hours.
Caisson then moved to next low opening.
When well ahead of water, usual forms were used and concrete placed as fast as the plant could mix it. Above El. 400, water was passed through vent 4
C.L. unit 4
Opening 1, El. 340
Opening 2, El. 342
Opening 3, El. 344
Opening 4, El. 346
Opening 5, El. 348
Opening 6, El. 350

FIG. 8—DIAGRAM OF STREAM CONTROL AND DAM CLOSURE

reservoir area. Hatcheries were established for breeding Gambusia or "top minnows" to be released in the reservoir as the water rose.

As soon as water began to accumulate in the reservoir, the spraying of all possible breeding places along the shore line with oil was begun. The equipment for this work consisted of ten small boats fitted with air

and oil tanks, spraying equipment, and outboard motors, one large launch with a large oil and air tank, one small barge with air compressor and oil tank for supplying the small boats, and several 1,000-gal. oil tanks located at convenient places on the edge of the lake. During the first season, about 40,000 gal. of oil were used and every breeding area was sprayed at least once every 10 days.

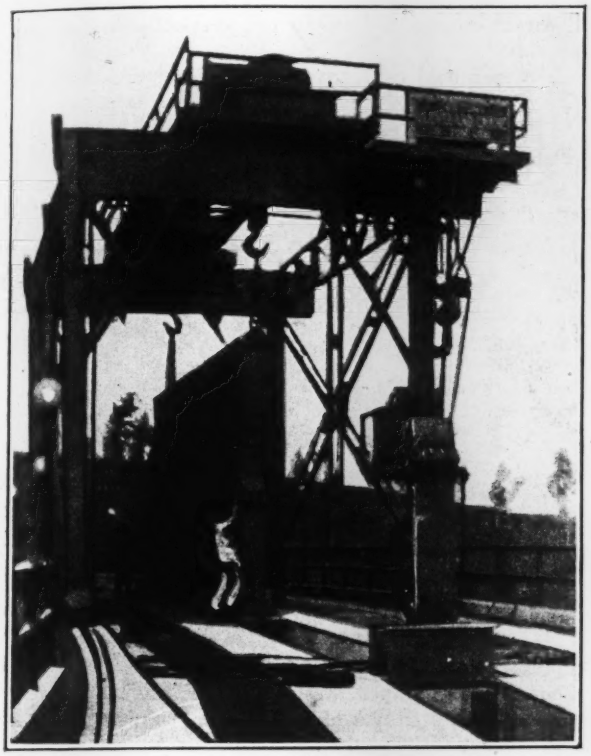


FIG. 9—GANTRY CRANE RAISING CREST GATE
This crane has a capacity of 40 tons and has a 5-ton gib. Gates are held in raised position by latches on posts which can be seen at end of gate and in right foreground. Opening for emergency or repair gates above each crest gate is under grating in foreground.

The oil used was 75 per cent kerosene and 25 per cent crude oil.

The spraying with oil will be continued during the next two or three seasons until the natural processes for the control of the mosquitoes are well established.

Concreting Plant and Methods—The mixing plant,

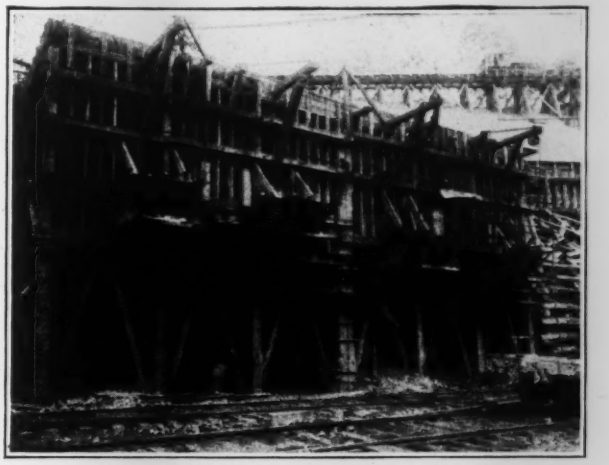


FIG. 10—COBBLE STONE STORAGE BIN

Fig. 11, contained two 4-cu.yd. mixers. Each mixer was driven by a 75-hp. motor. The mixing plant was so designed and arranged that the mixers dumped directly into concrete buckets on flat-cars on tracks in front of the mixing building. Also, the gravel bin of the mixing plant was the downhill terminus of the main gravel storage bin, so that the gravel or crushed rock flowed directly into its compartment until the angle of repose of the material was reached. The sand bin was located just downstream from the gravel storage bin. It was necessary to arrange a belt gallery in the downhill side of the sand storage bin. This belt gallery carried a 30-in. conveyor. The sand belt delivered to a small bin in the top section of the mixer plant. Automatic measuring tanks for water were installed and gave fair satisfaction. The greatest production in 24 hours from this plant was 2,422 cu.yd. The main sand storage bin had a capacity of 12,000 cu.yd. and the main gravel storage bin had a capacity of 10,000 cu.yd.

The main assembly of derricks for handling concrete and excavation consisted of eleven 20-ton steel guy derricks with 100-ft. booms and 115-ft. masts. The secondary group of derricks, at the dam, consisted of one 10-ton steel guy derrick with 60-ft. boom; one steel stiff-leg derrick of 20-ton capacity with 80-ft. boom; one steel stiff-leg derrick of 15-ton capacity with 60-ft. boom. All of these derricks were electrically driven. On the 20-ton derricks an 80-hp. hoisting engine with a 15-hp.

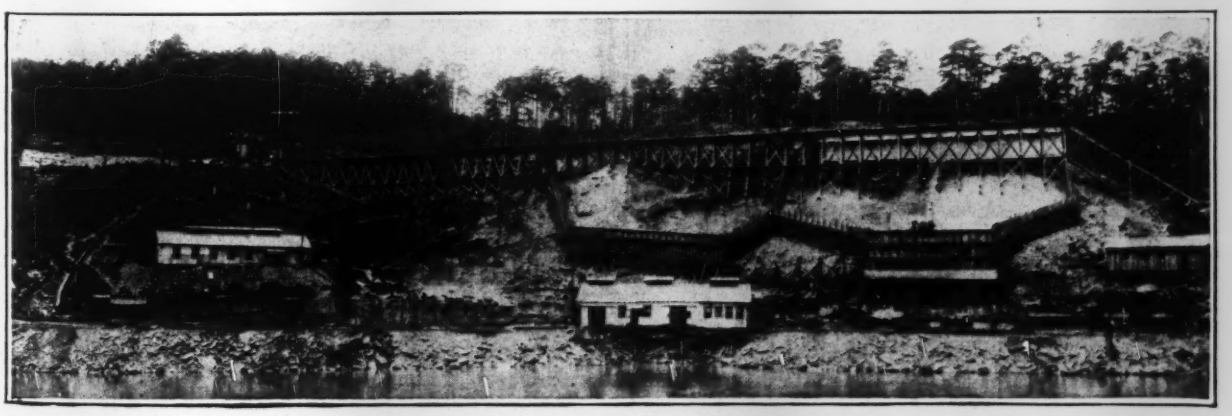


FIG. 11—AGGREGATE STORAGE AND MIXER PLANT

FIG. 12—PLUM STONES BONDING SUCCEEDING LIFTS OF CONCRETE

swinging engine was used. The hoisting engine had the following characteristics: 80-hp. electrically driven, single-line pull 10,000 lb., 200 r.p.m., double drum. The swinging engine had the following characteristics: 15-hp., electric, single-line pull 8,000 lb., 40 r.p.m., single drum.

Panel forms gave fine service in spillway, retaining section, corewall, portions of the headworks, and other sections. It is believed that this design of panels results in less delay in removal, minimum form failure, and a smoother finish than any other type which has been devised. Of course, special and more complex forms were required for the draft tubes, wheel pits, headworks, and spillway deck. Splendid results were experienced with the spillway deck forms with a max-

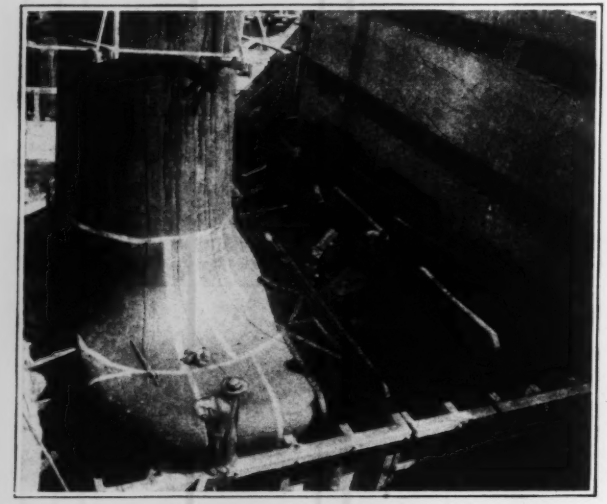


FIG. 13—FORMWORK FOR ONE OF THE DRAFT TUBES

imum clear span of 30 ft.; absolutely no deflection occurred in the finished concrete deck.

Various proportions were used in different sections of the structures. After 50,000 cu.yd. of concrete were poured, or after June 1, 1925, the Abrams method of pouring concrete was introduced, and followed throughout the remainder of the work. After the concrete mixing crews had become trained to this system of proportioning, no trouble was experienced with mixing, or changes of mixes. Undoubtedly, more satisfactory results were obtained, from both the economic and the strength standpoints. The product from the Abrams proportioning gave a smoother flowing mixture than had been obtained from the ordinary method of proportioning by the "old-time" ratios. The chief inspector was in direct charge of concreting, proportioning and inspecting.

A rather bold departure from ordinary methods was made in the use of cobbles, or 6- to 8-in.-diameter stone. The concrete buckets were first filled with the mixed concrete to a height which would allow placing 1 cu.yd., loose measure, of cobbles over the mixed concrete. The

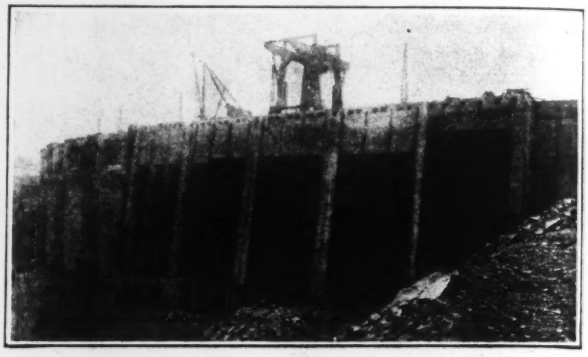


FIG. 14—UPSTREAM FACE SHOWING TRASH RACKS

concrete buckets, or the flat-cars, were then transferred to the cobble stone bin, to receive their surcharge of cobbles. After the admixture of cobble stone and mixed concrete was dumped into the forms, the cobble stones were carefully spread by hand labor, using shovels. It was found that the use of this cobble stone and mixed concrete combination was very satisfactory in mass concrete, and wherever reinforcing steel was not used. However, there was a certain small element of delay in the use of the cobble stones, due to the necessity of scattering and bedding the stones in the mixed concrete. Of course, these cobbles displaced an equal amount of mixed concrete. There was an important saving in the cost of concrete by using the cobbles. By careful placing, it is felt certain that a high quality of concrete was secured. Approximately, 32,000 cu.yd. solid measure of cobble stones were installed, being 8.1 per cent of the total concrete placed and being 9.4 per cent of the total mixed concrete installed, up to June 1, 1926.

As a quarry was operated at the project, large plumstones also were used in the mass concrete sections of the project. However, these plumstones were employed chiefly as bond stones between adjacent pourings of concrete, Fig. 12. Approximately 19,000 cu.yd. of plumstones were installed in the entire project, being 4.3 per cent of the total concrete installed up to June 1, 1926.

Hydraulic Equipment—The generating equipment at present installed in the power house consists of three 45,000-hp. vertical Francis type inflow turbines with runner and generator suspended on a main shaft supported at the top by a thrust bearing. The operating head varies from 150 ft. to 129 ft. Two turbines were furnished by the Allis-Chalmers Mfg. Co. and one by the William Cramp & Sons Ship & Engine Building Co. Headworks for a fourth unit have been pro-

vided in the dam, and the foundations of the power house have been carried out to include this unit.

Superintendence—The Engineering Department of the Alabama Power Co., at headquarters in Birmingham, made the studies, the general layout and the detail plans for all of the structures on this project. The design work was under the supervision of O. G. Thurlow, chief engineer and vice-president, with J. A. Sirnit, designing engineer, and F. E. Hale, assistant designing engineer. S. H. Woodard is consulting engineer for the Alabama Power Co. The construction work was carried on under the supervision and direct control of A. C. Polk, construction manager and vice-president of the Dixie Construction Co. C. C. Davis was superintendent of construction at Cherokee Bluffs. The writer was in charge of all field engineering and design. C. R. Hopper was chief inspector of mixing and placing concrete. He was also responsible for the operation of the completely equipped testing laboratory at the project.

The Dixie Construction Co. is a subsidiary of the Alabama Power Co., carrying on all the construction operations required by the latter company. However, its activities are confined entirely to the power company.

Applying Principles of the Catenary To Roof Design

Suggested Designs for Suspension Roofs Result from Study of Small-Scale Models—One Type Constructed on a 10x12-Ft. Building

By Martin Elizondo
Civil Engineer, Mexico City, Mexico

SEVERAL suggestions and proposed types for suspension roofs have resulted from studies and experiments which the author has pursued at intervals since about 1917. Small-scale models of the various types were made from sticks and pieces of chain. Those types described here are believed to be new and to offer certain advantages.

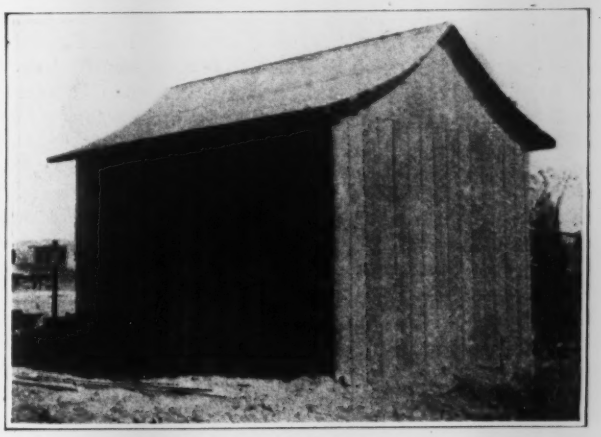


FIG. 2—SUSPENSION ROOF ON 10 x 12 FT. BUILDING
Design is Similar to Fig. 1-A.

The catenary formed by a suspended cable or chain when loaded assumes the shape of the working tension line, as opposed to arches whose deformations create moments and increase the total stresses. For the same reason deformations in beams and in columns or in struts are objectionable beyond certain limits. It is also a well-known catenary principle that the stresses decrease as the ratio of the deflection to the chord length increases. For example, in a catenary of 0.4 deflection of the chord length, the weight of the roofing materials exerts a tension at either suspension support of 0.589 of the total weight on the whole catenary while with a deflection of 1/40 the tension is 5.03 times the load. (Trautwine's Civil Engineers' Handbook).

The sketches in Fig. 1 and the view in Fig. 2 illustrate one of the more simple suspension arrangements using steel cables. As shown, triangular trusses afford a central suspension anchorage from which the two symmetrical parts of the catenary arrangement hang down on either side. It will be noted that only three forces act on the truss, one being a combination of the two catenary reactions acting vertically on the apex of the truss, and the other of the lateral forces acting at

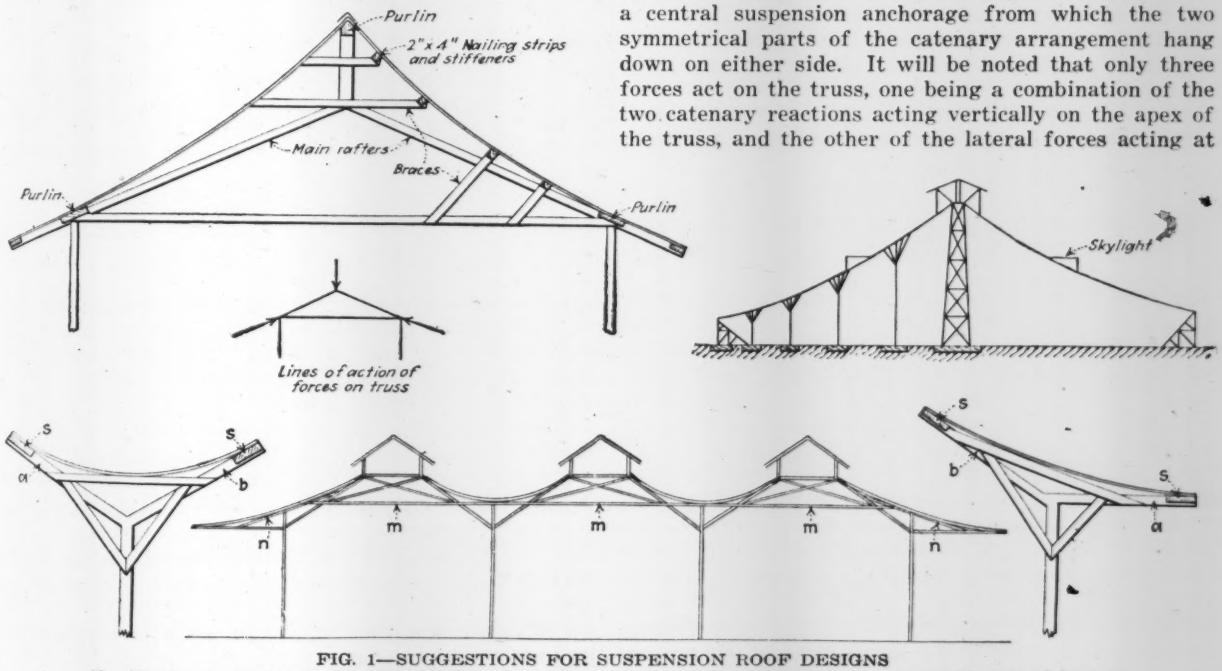


FIG. 1—SUGGESTIONS FOR SUSPENSION ROOF DESIGNS
A—Simple truss support. B—Combination of suspension and cantilever details for building with several bays.
C—Central support with radial cables for circular building.

the bottom of the truss. The lines of action of these forces are shown by a small line sketch in Fig. 1.

In combination with this truss there is required only a purlin on the top which is held by a strut at the apex and two side purlins secured directly on the lower end of the main rafters. Boards can be nailed between the upper purlin and to the two side purlins, following very closely the catenary curve. This sheeting can then be covered with tar roofing or similar material in which event longitudinal 2x4's should be placed beneath where the roofing overlaps so as to provide a nailing strip. These same pieces in combination with short braces help to check the roof deformations caused by wind loads. At the same time the compression or unsupported length of the main rafters is reduced on account of the intermediate fixed points the braces afford. Sheet metal roofing can also be used, doing away with the board sheeting, but retaining the 2x4's for nailing strips and for providing support for the laborers during erection of the roof. Steel trusses can of course be used instead of wood. It is to be noted that the upper and side purlins are the only supports for the suspension roofs, the 2x4's and braces being auxiliary.

Another arrangement for suspension roofs is shown in *B*, Fig. 1, where a combination of a cantilever and catenary system is used. The two enlarged details show that the frames at both the suspension and the suspension cantilever joints consist only of two compression members, marked *a* and *b*, and the catenary roof structure. The pieces marked *s* are beams framing into the compression members and anchoring the catenary roof. The cross braces *m* and *n* are used in combination with longitudinal 2x4's to afford rigidity to the structure against wind pressure and to reduce the unsupported length of the compression members.

Sketch *C* in Fig. 1 gives a third suggestion, using a central support and radial cables. To take care of deformations for varying wind loads vertical ties anchored to underfloor foundations and branched from a certain height to support several points of the main cables can be used. Glass-covered spaces of roof can provide daylight, and ventilation can be supplied by cupolas or similar construction.

Standards Bureau Makes Largest Optical Flats

Three optical disks with less than two ten-millionths of an inch deviation from perfect flatness have been produced by the United States Bureau of Standards and will henceforth be used as master flats in determining whether any surface approaches flatness or straightness. The three disks are from 10 to 11 in. in diameter and 1½ in. thick. They are made from clear fused quartz, or silica glass, produced in the Thomson Research Laboratory of the General Electric Co. at Lynn, Mass. Compared with optical glass, this fused quartz is harder and has a coefficient of expansion one-fifteenth less when heated, which properties make it less sensitive. The three disks were ground in the optics division of the Bureau of Standards and then polished by hand with extreme refinements of method. They were then tested by the method of observing interference bands of light when the surfaces were laid together and viewed from an exact perpendicular. In addition to serving as a test for flatness of surfaces and straightness of edges, these standard or master flats are used in the production of standard angles and for calibrating or checking instruments that measure curvature.

Aerial Surveys Lend Confidence on Hastily Organized Job

Plat of 18,000 Acres of Undeveloped Land Surveyed in Minimum Time—Conclusions Drawn from Aerial Photographs

By Karl Riddle
President, Riddle Engineering Co., Inc.,
West Palm Beach, Fla.

IN DEVELOPING 18,000 acres of land at Boca Raton, Fla., speed in completing the preliminary surveying, plotting and planning was the most important requisite, as on a majority of the Florida developments. At the time the survey was made the town of Boca Raton probably included a population of about 200 people. It was surrounded by undeveloped territory, very little of which was accessible by road or trail. No accurate maps were available, the only survey of the territory having been made by the United States government in 1858, followed by the Lake Worth Drainage District survey in 1915. The latter destroyed many of the government stakes in connection with its ditching work, although a fairly accurate record was kept of the relation of the ditches and canals to the original corners.

The aerial survey was authorized in April, 1925, and it was required that the first plat be ready for sale in July. There was thus no time to set control points and define them on the ground by means of white markers. It was decided that the ditches and canals would serve as control lines, and then by resorting to the drainage district field notes the aerial photographs could be coordinated by projecting the section lines upon them. Other monuments, such as highways, railroads, and clearings help to identify survey lines on the map.

Eighty-seven prints were used to make the map which, when completed, was made to an accurate scale of 800 ft. to the inch. The trails which it was possible to plot on the map indicated the higher land, for they were made by Indians and early settlers at a time when the land was subject to overflow. It was also possible to locate rock, because in cutting the canals a dipper dredge had been used where there was rock and a suction dredge where there was sand. The spoil bank from the rock cut was covered with vegetation, and was so shown, while the spoil bank from the suction dredge was bare and showed as a wide white strip. A stone quarry, known only to farmers in the locality, was located by an aerial photograph, and yielded about 100,000 cu.yd. of rock which was used for waterbound macadam roads and for coarse aggregate. Later it was determined that very little rock was available in the district, and the discovery of this quarry proved of aid.

The character of the vegetation was used to determine elevation above the sea level to an accuracy within a few feet. For example, sand pine grows on well drained higher land, yellow pine grows on well drained fertile land, but of slightly lower elevation. Cypress grows on muck land, subject to overflow, and saw grass grows on the muck land in need of drainage. Several streams, lakes and marshes whose banks were bordered with rank tropical vegetation and that had never been surveyed were mapped quite accurately.

The oblique view, on the left in the illustration, shows the territory contiguous to Lake Boca Raton. The

© Fairchild Aerial Surveys, Inc.

AN OBLIQUE (ABOVE) AND A VERTICAL (LEFT) VIEW OF THE SAME SECTION

Eighty-seven vertical prints were used to make the complete map of the territory.

canal running from south to north across the photograph is owned by the Florida Coast Line Canal & Transportation Co. From the contrast between the east and west banks of the canal the following conclusions were made: The material on the east bank was sufficiently loose to level down by erosion, and therefore was not rock, nor was it marl or loose rock that will bind when placed above water, as in the case in many instances in this section of Florida. The west bank was above water since it was covered with some vegetation.

The cross-channels in the east spoil bank indicate that there is considerable waterflow from the canal emptying into the lake at the south end, which water reaches the ocean through the natural inlet connecting the lake and the ocean. An important fact in the aerial survey was that this conclusion resulting from an examination of the photographs was deduced in less than an hour, while to have studied the flow of water, and made soundings to determine the shape of the spoil bank, and the natural cementation of the material in the spoil bank, would have required at least a week's time, besides equipment which was not at hand.

Aerial surveys make an employer of hastily organized engineering forces feel much more secure than when an ordinary survey must be conducted under pressure.

The aerial surveys for this work were made by Fairchild Aerial Surveys, Inc., of New York.

Studies and Works of a Missouri Drainage District

Adjacent Districts Co-operate for Outlets—Runoff Formula—Assessments and Taxes—Flat Side Slopes Prevent Caving of Ditches—Pumping Plant—Profit-Sharing Contract and Cost Accounting

By Jacob A. Harman
Elliott & Harman Engineering Co., Peoria, Ill.

AN IMPORTANT Missouri land drainage and reclamation project now being carried out is that of the Elk Chute drainage district, comprising about 55,000 acres of comparatively level alluvial land formed by the Mississippi River and its tributaries in the southeast part of the state, near the Missouri-Arkansas boundary. The major part of this area was acquired as a timber preserve more than twenty years ago by the Deering Harvester Co. (now part of the International Harvester Co.). With the cutting of the timber and the agricultural development of the surrounding territory, the owners decided to drain the property and develop it for sale for agricultural purposes. A typical main ditch through this district is shown in Fig. 1.

Location and Topography—The Elk Chute Drainage District, in Dunklin and Pemiscot counties, lies in the trough of the Little River valley immediately above Big Lake, which is an expansion of the river. This district, with adjacent drainage districts which affect it, is shown in Fig. 2. The Little River joins the St. Francis River in Arkansas, about 50 miles below the Arkansas-Missouri line. Its watershed is principally Mississippi bottom land protected from overflow by the Mississippi River levee system. The area of this alluvial section, which finds its drainage through the Little River in Missouri, is about 2,000 sq.mi. and extends from the vicinity of Cape Girardeau about 90 miles south to the state line, with an average width of about 25 miles.

The land slopes from the Mississippi River westward to the Little River valley, which is 20 to 30 ft. lower than the west bank of the Mississippi River, and the distance across is from 20 to 40 miles. From north to south the general slope is about one foot per mile, so that the natural drainage tends westward from the bank of the Mississippi and down the valley to the St. Francis River, which empties into the Mississippi just above Helena, Ark.

This is a highly fertile area on the border between the cotton belt and the corn belt. For some 40 miles north of the state line excellent yields of cotton are produced; corn, alfalfa and smaller grains and forage grasses also produce abundantly. Practically all the original growth of hardwood timber has been cut, and as the land is relatively flat, but with many slight depressions and ridges, drainage was necessary for successful agriculture. Ditch work was begun many years ago by individuals, and later by organized drainage districts operating under the state laws, resulting in partial reclamation of a large portion of the area.

This drainage work concentrated the water in the low portion of the Little River valley through its entire length, and about fifteen years ago the Little River Drainage District was organized, comprising the trough of the valley, averaging about 90 miles north and south, and about 10 miles wide. Works for this extensive district were constructed as described in *Engineering News-Record* of Sept. 24, 1925, p. 496, and in *Engineering News* of March 18, 1915, p. 519 and Aug. 24, 1916, p. 342. At the lower end of the Little River district and just above the Missouri-Arkansas line there was left an area still subject to overflow. This area was organized in 1918 as the Elk Chute Drainage District.

Drainage Works—Drainage and flood protection works in the Little River valley, in Arkansas, provide for levees on both sides of Big Lake and Little River to hold flood stages at about 6 ft. above the general level of a large portion of the south end of the Elk Chute district, making it necessary to protect this district from overflow of the Little River and the backup from the basin of Big Lake. The general slope of the district is about 15 ft. from north to south and about 8 ft. from east to west. The plans provide for diversion ditches and floodways north and south of the district to carry off the floodwaters coming from the higher lands lying north and east of the district. By extending these canals to connect with the Little River, the Elk Chute area is surrounded by levees made of earth from the canals, as shown by Fig. 2.

Thus the problem of drainage within the district was reduced to local rainfall. It was found that only about 40 per cent of the district is below the flood level of the outlet, so that the remaining 60 per cent could be drained by gravity. Separate canals for the area below the flood level at the state line are provided with pumps to take care of the drainage during the flood periods, of a few weeks each year. During the ordinary stages of the Little River and for the greater portion of every year the area will drain through the ditches by gravity.

These conditions led to the development of three main outlets: (1) Serving the land which is high enough to drain by gravity at all stages of the Little River, (2) a middle area which would drain by gravity at all except very high flood stages which persist only for a few days and may not occur for years in succession, and (3) for the lower area requiring pumping during any ordinary high water of the Little River. With these outlets established and their respective areas defined, the remaining problem of drainage was provided for by lateral ditches leading to the main drains and by sub-laterals a half-mile apart, to serve every 40-acre tract.

Joint Works—Prior to the organization of the Elk Chute district, all of the remaining area of Pemiscot County east and north of this district and at a higher elevation had been organized into four principal drainage districts (see Fig. 2), while part of the northwest part of the county was included in the Little River district. All of these districts had outlets leading to and discharging over the surface of the land which became the Elk Chute drainage district. Since outlets were inadequate, the Pemiscot districts obtained adequate outlets by co-operating with the Elk Chute district and making a substantial contribution for the two main outlets and levees of the latter district. The cost

of these works, some $800,000, was borne pro rata, per acre, by Pemiscot County districts and Elk Chute district, the total area contributing being about 250,000 acres. The former districts also reconstructed more than 200 miles of their main and lateral ditches.

Ditch Section and Design—Reconstruction work in the Pemiscot County drainage districts, 1919 to 1923, preceded the construction of the outlets and the interior

FIG. 1—TYPICAL MAIN DRAINAGE DITCH
Side slopes 1 on 3; with 5-ft. berms and leveled spoil banks

ditches of the Elk Chute district. Following the usual practice, floating dipper dredges were used by the contractors. The ditches were designed for enlargement with side slopes of 1 on 1, with such width and depth as necessary to carry below the surface the estimated runoff. Owing to silting and caving the ditches did not correspond to their original constructed dimensions or design. When the reconstruction work began, the theory was that the ditches could be made permanent and avoid silting and caving by constructing the slopes carefully at 1 on 1, avoiding undercutting of the banks, requiring that the full cross-section be excavated as the work progressed, and leaving a 10-ft. berm between the ditch and spoil bank. By February, 1920, about 20 miles of ditches had been constructed, conforming very accurately to side slopes of 1 on 1. But as soon as the ground was fully saturated, early in February, very extensive caving or sliding occurred, in some cases extending so far as to deposit 2 to 5 ft. of earth in the bottom of ditches 10 to 15 ft. wide at the bottom.

These conditions in the Pemiscot County work led to an extensive investigation, participated in by the engineers of the Elk Chute district, the engineers of drainage investigations of the U. S. Bureau of Public Roads, the engineering department of the Missouri State University, and many other persons locally interested in the problem. As a result of these investigations, the engineers for the Elk Chute district concluded that it was necessary to use much flatter side slopes. The slope finally recommended was 1 on 3, based upon more than fifty years experience in building levees in this region to hold the Mississippi flood-waters. The Pemiscot County districts adopted these suggestions for a large part of the reconstruction work and ditches with 1 on 3 slopes are in excellent condition, while with steeper slopes there is much deterioration.

The Pemiscot County drainage ditches cross a number of ridges, some of which are 5 to 10 ft. above the surface of the land for which an outlet is provided. Prior to the reconstruction, none of these ditches through the ridges had been maintained to grade depth, all having been constructed by floating dredges in the usual manner with steep side slopes. Ditches that have been reconstructed with 1 on 3 slopes are remaining substantially at grade, some at depths of 18 to 22 ft. Even where these ridges are of water-bearing sand and joint clay, the flat slopes are effective.

Berms and Slopes—Although the Pemiscot County plan called for berms 15 ft. wide, the center line of the new ditch sections was staked out to coincide with the center line of the old ditch, as this required less excavation than any other plan. Since the new sections are larger, the slopes came near the center of the old spoil banks and all excavated material was placed back of the old bank. This plan resulted in a straight slope from the bottom of the ditch to near the top of the old spoil bank, no berm being formed. Careful study proved that neither the weight of the old spoil bank nor the depth of the ditch influenced the caving of the banks, but that when the banks did cave there was more material to slide into the ditch where the slopes were steeper. When the slopes were changed to 1 on 3, after one side of the ditch had been dug in the usual way with the dipper dredge at 1 on 1, the 1 on 3 slope on the other side came back of the old spoil bank. This finishing work was done with dragline equipment, and wide clear berms were left.

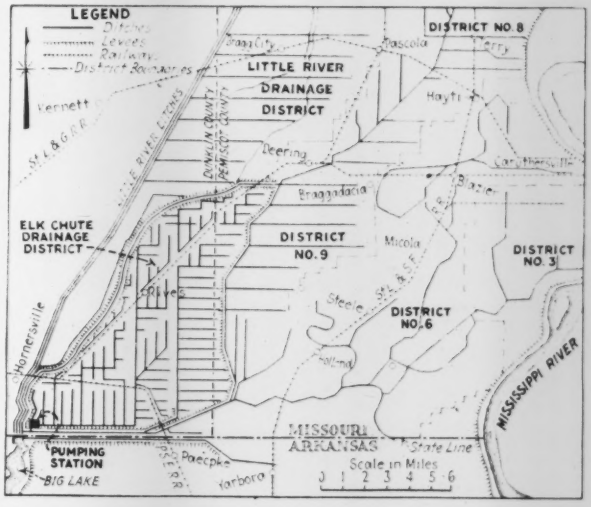


FIG. 2—ELK CHUTE DRAINAGE DISTRICT IN MISSOURI

In view of these experiences with the Pemiscot County reconstruction work, all ditches in the Elk Chute drainage district are constructed with side slopes of 1 on 3 and the excavated materials were deposited from the bucket in the spoil banks with flat top and even grades so as to be readily leveled with a road grader and put into cultivation. This typical section is shown in Fig. 3. The view in Fig. 1 shows the flat ditch slopes, 5-ft. berm and level spoil banks with a dense timber growth on both sides.

The entire area of the Elk Chute drainage district was virgin timber or cut-over land, with no farming operations at the time of the organization of the district, no part of the area being free from overflow. The Wisconsin Lumber Co., operating a sawmill at Deering, Mo., owns 95 per cent of the land. It is estimated that in about five years the entire merchantable timber will be removed from the tract. Meanwhile, the owners are clearing up demonstration areas in various parts of the district, putting them into cultivation and offering the cut-over land for sale to farmers.

Hydraulic Features—The drainage ditches of the Elk Chute district and the adjacent Pemiscot County districts were designed to provide for a runoff, without overflowing, from a rainfall of 3 in. in 24 hours on a saturated watershed, using the Elliott & Harman formula, which we developed about the time these studies were being made. For the Elk Chute district

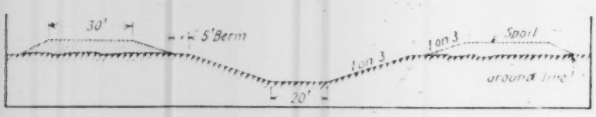


FIG. 3—TYPICAL DITCH SECTION

and a portion of Pemiscot County, which is heavy clay, we used the factor $C = 0.4$; for the portion where the soil was partially sandy loam we used $C = 0.3$. In this formula, Q is runoff in second-feet per square mile; C is a factor of experience; F is slope of watershed in feet per mile; P is rainfall in inches in 24 hours; M is drainage area in square miles. We found that in a period of 17 years of rainfall records at Caruthersville, Mo., a rainfall of 3 in. or more in 24 hours occurred 17 times; and a rainfall of 4 in. or more in 24 hours occurred four times. The formula is

$$Q = C\,22.8\,\frac{F^{\frac{1}{2}}\,P^{\frac{5}{2}}}{M^{\frac{1}{10}}}$$

Construction Work—The construction program for the drainage works of the Elk Chute drainage district is set up in four principal divisions: (1) The levees around this district and the outlets for the Pemiscot County districts, under contract with the former; (2) the 50 miles of main ditches in the Elk Chute district; (3) the laterals a half-mile apart, and (4) the pumping plant. The first two divisions of this work have been completed and drainage culverts with gates have been provided through the levees, so that when the water in Little River is low the gates will be opened and natural gravity drainage will be effective. When the Little River is in flood, the gates and levees will exclude the flood water from the lower areas, and until the pumping plant is installed the rain water and seepage will be retained in the low area of the district until the flood has passed. Fig. 4 shown a typical outlet.

As a large part of the low area of the district is still virgin timber, there is no occasion for the construction of the pumping plant until this timber has been removed and the land is needed for agricultural purposes. Likewise the laterals will be constructed only as the land adjacent to each lateral is ready to be put in cultivation. This policy will save the interest on a large part of the construction cost for a number of years and will also avoid the cost of maintenance and upkeep of many miles of laterals until needed for farming operations.

Benefits—Since the Elk Chute drainage district includes parts of the Little River district and of the Pemiscot County districts, the taxes levied by these other districts were considered in determining the benefits to the several tracts of land in the Elk Chute district. The commissioners in assessing benefits divided the district into four zones: the first one of the higher area at $50, and the others at $45, $40 and $35 per acre. These figures were used as the total benefits, including the taxes which had been levied by other drainage districts on lands included within the Elk Chute district, and the benefits upon which the taxes for this district are to be levied were reduced by the various amounts of taxes previously levied on each such tract.

Benefits assessed in the Elk Chute district totaled $2,126,424. The estimated cost of the work, including court costs and incidentals, was $727,798. Taxes levied on lands within this district by other districts in which the same lands are located amount to $329,364, making a total tax of $1,057,162 against the lands in the Elk Chute district. These figures are exclusive of interest for deferred payments and represent the approximate basis for the bond issues. Therefore, the bond issues on the Elk Chute district will be approximately 50 per cent of the total benefits, and the annual interest

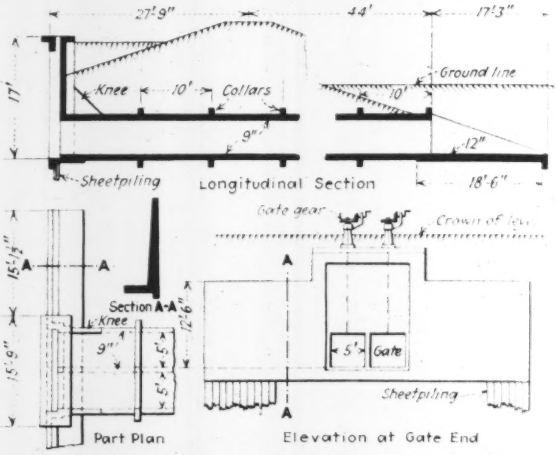


FIG. 4—DITCH OUTLET WITH REGULATING GATES

charges for 25 years will aggregate an equal amount, representing an average of about $20 per acre for construction and $20 for the deferred interest, so that the total bond issue and interest taxes to be paid will approximate $40 per acre in equal annual installments for 25 years. The bonds mature serially, beginning five years after date, so only interest is paid for the first five years, requiring an annual tax on the district equal to 6 per cent of the bond issue. For subsequent years, there will be a uniform tax on the amortization basis, requiring a total annual tax of about 8 per cent of the total bond issue for a period of about 24 years.

Construction and Contracts—The outlets for the Pemiscot County districts, including the levees around the Elk Chute district and the interior main drains of the latter district, have been constructed under profit-sharing, stop-cost contracts by the W. E. Callahan Construction Co., of Dallas, Tex. The amount of work in the outlets and levees was 3,590,377 cu.yd. at a base price of 11c. This contract was awarded March 25, 1922, and work was completed Aug. 12, 1924. The contract for the construction of the interior main ditches was awarded Oct. 27, 1923, and completed May 22, 1925. This work was in two price divisions, 2,000,306 cu.yd. at 13½c. and 407,853 cu.yd. at 15c. per cu.yd., the 15c. work growing out of an adjustment on the first contract.

The contractor furnished all the equipment and the district paid all the expense of installation and operation, clearing, upkeep and repairs during the period of the contract up to a total of the base price cost, including contractors' compensation for the use of the

equipment. This compensation was 2c. per cu.yd. of excavation as rental on the equipment, and if the total cost, including this rental, was less than the base price, the contractor was paid an additional compensation equal to half of the savings, the other half being retained by the district.

Under this arrangement the district furnished the accounting organization at its own cost and the contractor furnished a general superintendent in charge of the work at his own cost. All other employees in the supervision and the construction of the work and all materials and repairs were charged at cost. The chief engineer of the drainage district had full charge and control of all the accounting, and countersigned all checks for payment for supplies, labor, payroll and other costs in the construction work.

Four 3-yd. draglines, one 2-yd. steam floating dipper dredge and one 3-yd. electrically-driven floating dipper dredge formed the main equipment. In addition, one or two small draglines were used for portions of the work. Trucks and tractors hauled equipment and materials and assisted in clearing the right-of-way. All dragline machines and the electric generator on the 3-yd. dredge were operated with internal combustion engines of the semi-Diesel type. The contractor established headquarters at Deering, Mo., on the Deering-Southwestern R.R., and erected a repair shop where practically all repairs for the machines were made.

Clearing the right-of-way was laborious and expensive, as all the work was through heavy timber or cutover lands with a remaining growth of unmerchantable trees. In the heavier levee work, the cost for clearing and shooting the stumps averaged about 2c. per cu.yd.; in the larger drainage ditch work, the clearing of the right-of-way cost about 3c. per cu.yd. of excavation. The cost of clearing was included in the base price cost.

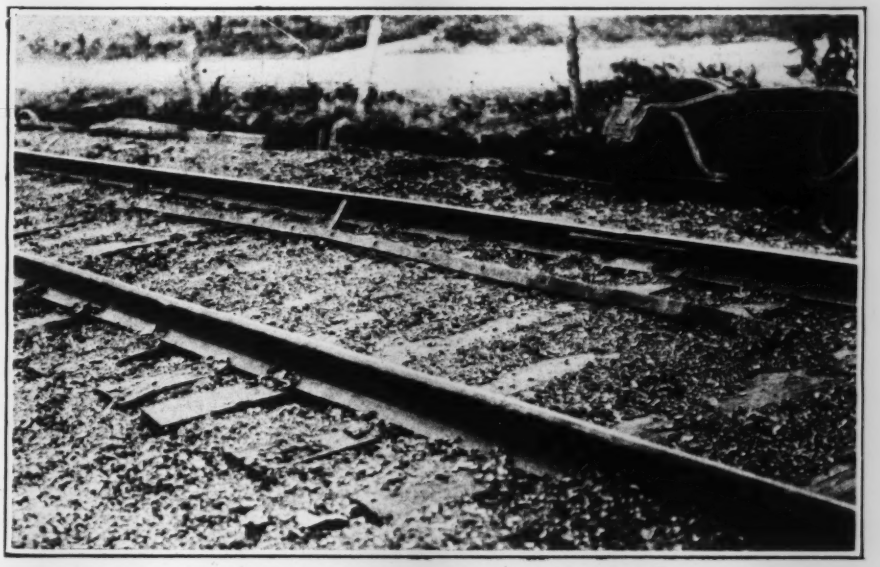
Cost Accounting—A system of accounts was set up in the engineer's office for keeping a record of all purchases of materials and supplies, and for issuing these to each separate machine and crew, so that the cost was kept in detail for each unit of operation. The contracts were kept as separate accounts and the experience on both contracts indicated that the base price was very near the cost of the work and the contractor's compensation consisted in the amount of rental which he was paid for the use of his machines. The funds for carrying on the work were furnished directly by the drainage district, so that the contractor was relieved of financial and accounting responsibility in connection with this operation.

In order to facilitate the keeping of the records of the materials, supplies and labor, special forms were printed and used in the accounting system. All purchases were consigned and charged to a warehouse account and when issued to the various operations on the work were charged to these operations. As this led to a great deal of detail accounting for the warehouse stock ledger, that ledger was discontinued and reliance was had upon inventories to determine when additional stock would be required. But throughout the entire construction period, every article was charged out to the particular operation to which it was assigned, so that detailed costs were kept on each construction operation and if there was any shortage or loss in warehouse materials it was charged into the general overhead account.

The Elliott & Harman Engineering Co., Peoria, Ill., acted as engineers in charge of the work.

Unusual Rail Dug Up in Illinois

IN CLEARING up the track following a derailment near Jacksonville, Ill., in which the subgrade had been plowed up by derailed wheels, a piece of old rail of the strap type was found. The rail is shown in the accompanying illustration, laid between the rails of the existing track.



STRAP RAIL FROM RAILROAD BUILT IN 1838

S. M. Smith, assistant bridge engineer of the Wabash Ry., who sends the photograph, states that these strap rails came from the East and were brought up the Illinois River to Meredosia, in May, 1838, and were used on the first railroad to be built in the state of Illinois. They were 2 in. wide and ⅜ in. thick, varying in length from 15 to 20 ft. These iron straps had holes drilled in them at about 14-in. centers by which they were spiked with ordinary 20d. nails to the top of wooden rails 2½ in. wide on top and 3 in. wide on the bottom. These wooden rails rested on cross-ties, which in turn rested on longitudinal wooden sleepers 1 ft. square laid on the ground.

The railroad was built by the state of Illinois for the Northern Cross R.R. under the provisions of the Internal Improvement Act of 1837. Work was begun on this line in May, 1837, and construction completed in May, 1842.

Relation of Zoning Ordinances to House Widths

Proposed Altoona Ordinance Based on Formula Devised and Designed to Meet Practical Requirements—Some Contrasts

By Arthur Richards
Planning Engineer, City Planning Commission, Altoona, Pa.

In preparing the proposed zoning ordinance for Altoona, Pa., a study was made of the average size and width of dwellings. After determining minimum widths for the various types of houses and the widths of side yards required for light, air and privacy, the schedule of height and area regulations as shown in Table I was devised.

Generally, the sizes of lots are established on the theory that they are intended primarily for single dwellings. If any of the lots are to be used for multiple dwellings, the various widths of lots for these different structures should be double, half or quarter divisions of single units so that the proper combinations can be made without having more land than is necessary to comply with the side-yard requirements. Therefore it is obvious that the area of a lot must be related to the lot depth, for without such a specific relation an ordinance cannot ensure proper-sized houses or buildings, and thus fails to accomplish one of its primary purposes.

In the Altoona schedule, formulas are devised which control the minimum widths of lots that are acceptable for building purposes, and the lot area per family is so graduated as to provide adequate room for any and all types of dwellings. No lot which is over 120 ft. deep, or less than 100 ft., can affect the width of the lot and thus there is a definite assurance that a proper-sized house can be constructed on a lot and still have the space required for the side yards.

After preparing the schedule an examination was made of some existing zoning ordinances and it was found that while provisions were made in these ordinances for open spaces or yards there was not provided sufficient width to the lots to allow for building suitable width houses.

Part I of Table II shows the sizes of buildings which can be placed on the lots under the Altoona zoning schedule. These sizes are adequate for all general standard purposes. Ample space is provided for the essential side yards and the lot is so arranged as to avoid waste of land.

Part II of Table II shows that in the minor business district of a Pennsylvania city, which allows a single house to be built on a lot area of 2,400 sq.ft., that if the lot is 150 ft. deep the width of the house which could be built would not be more than 8 ft. Also, if a 5-story, 10-family building is desired in this district, then a lot 80 ft. deep would have to be 125 ft. wide, which would mean that a large amount of land would be wasted, as a building 49 ft. wide having side yards of 16 ft. would be ample. It may be argued that no one would be so foolish as to build single houses 8 ft. wide or double ones 12 ft. wide, but if such is the case then why include such widths in the ordinance, and if a 65-ft. lot is wide enough for a 5-story building why make a purchaser buy a 125-ft. lot?

Parts III and IV of Table II, based upon zoning ordinances of a Pennsylvania and an Indiana city respectively, show further extremes, in that, on some lots there would be no room left at all to build houses after the side yards were deducted from the widths of the lots, and surely lots 80, 100, 120, and 150 ft. deep are average depths which abound in most cities.

In Part III of Table II, on a lot 80 ft. deep in the 45-ft. Residence B District, a lot 62 ft. wide is required for a 4-family 2-story building, while a lot 93 ft. wide is required for a 6-family 3-story building. In actual construction practice a 3-story apartment would be only as wide as a 2-story one, but still the ordinance provides that 31 ft. more of ground must be purchased or used, the required side yards being the same for both buildings.

The Altoona schedule, Part I of Table II, shows that the graduated lot areas per family of the schedule will always provide an adequate number of ample size rooms for each family, as, a 10-family, 5-story building, on a lot 100 ft. deep, allowing 650 sq.ft. lot area per family will allow for six rooms 20 ft. by 12 ft. for each of the ten families, which space is more than is used in most apartments. In contrast, Part II of Table II requires 1,000 sq.ft. per family, which would mean that a building 1.47 times the size of the Altoona one could be built, or that the side yards of the lot would amount to 51 ft., whereas 16 ft. would be sufficient, and it is evident that neither of these plans is economical.

TABLE I—SCHEDULE OF HEIGHT AND AREA REGULATIONS ALLOWED BY ZONING ORDINANCE, ALTOONA, PA.

To provide the required width of lots in the various districts, the formula for all lots having a depth of 110 ft. or more shall be, Families × Area ÷ 120, even though the actual lot area exceeds the schedule requirements; and for all lots having a depth of less than 110 ft. the formula shall be, Families × Area ÷ 100, provided that in no instance shall the area of a lot be less than that required in the Zoning Ordinance.

Height and Area District	Use District	Height Limits		Lot Area per Family Minimum Sq.Ft. Required										Yard Regulations for Dwellings. Yards required: 1-front, 2-side, and 1-rear. Regulations also apply to other buildings where provided for in the Zoning Ordinance.				
					Families per Lot or Building									Front Yard Depth in Ft.		Side Yard width in Ft.	Rear Yard Depth in Ft.	
		Stories	Feet	Depth of Lot	1 Single	2 Double	2 Duplex	4	6	8	10	12	Over 12	Minimum	Max.		Minimum	Max
1	Residence A.	3	40	110 ft. or more.	4,800									20	30	Minimum width for either side yard 4.00 ft. the sum of both yards to be not less than 12.00 ft.	25% of depth of lot, but not less than 20 ft. from rear lot line.	30
				Less than 110 ft.	4,000													
	Residence B.	3	40	110 ft. or more.	4,800	3,600	2,400	1,800	1,500	1,500				15	30			
				Less than 110 ft.	4,000	3,000	2,000	1,500	1,250	1,250								
2	Residence C. Business A.	5	66	110 ft. or more.	3,600	3,000	2,100	1,500	1,000	900	780	750	680	10 ft. for 2 story building. Increase 2 ft. for each other story.	20	Minimum width of each side yard 4 ft. for 1 to 3-story building. Increase each yard 2 ft. for each other story.	20% for 1 to 3 story. Increase 3 ft. for each other story.	30
3	Business B. Industrial A. and B.	7	90	Less than 110 ft.	3,000	2,500	1,750	1,250	830	750	650	625	570				15% for 1 to 3 story. Increase 3 ft. for each other story.	25

An examination of Table II in reference to the width of a double house which could be built on a 120-ft. depth lot in a Residence B District, shows it is essential that the families and areas per family must be related to the depth of the lot if the graduated areas are to mean anything:

Part	Lot, Width	Double-House, Width	Side-Yard, Width
I	60	48	12
II	40	32	8
III	31	17	14
IV	17	5	12

Further examination of the tables will show that the zoning ordinances for Parts II, III and IV of Table II are inconsistent and unreasonable in many provisions, and that if strict enforcement of the ordinances were attempted trouble would result.

If zoning is to accomplish the good expected of it then it is evident ordinances must be able to stand the test of common sense and reason, must be consistent and fair in their requirements, and must be able to stand on their own foundations before public opinion.

TABLE II—ANALYSIS OF SOME ZONING ORDINANCES SHOWING LOT AND BUILDING WIDTHS OBTAINABLE

Height and Area District, Ft.	Use District	Depth of Lot	1-Family Single House: Area per family, Sq. Ft.	1-Family Single House: Width of Lot, Ft.	1-Family Single House: Of Side Yards,	1-Family Single House: Of Building, Ft.	2-Family Double House: Area	2-Family Double House: Lot	2-Family Double House: Yards	2-Family Double House: Building	4-Family 2-Story: Area	4-Family 2-Story: Lot	4-Family 2-Story: Yards	4-Family 2-Story: Building	6-Family 3-Story: Area	6-Family 3-Story: Lot	6-Family 3-Story: Yards	6-Family 3-Story: Building	8-Family 4-Story: Area	8-Family 4-Story: Lot	8-Family 4-Story: Yards	8-Family 4-Story: Building	10-Family 5-Story: Area	10-Family 5-Story: Lot	10-Family 5-Story: Yards	10-Family 5-Story: Building
I. Proposed Ordinance of Altoona, Pa. *Over = 110 ft. or more. †Under = less than 110 ft. See formulas																										
40	Res. A.	Over*	4,800	40	12	28																				
		Under†	4,000																							
	Res. B.	Over	4,800	40	12	48	3,600	60	12	48	1,800	60	12	48	1,500	75	2 stor'y 12	63	1,500	100	2 stor'y 12	88				
		Under	4,000				3,000				1,500				1,250				1,250							
66 and 90	All others	Over	3,600	30	8	22	3,000	50	8	42	1,500	50	8	42	1,000	50	8	48	900	60	12	48	780	65	16	49
		Under	3,000				2,500				1,250				830				750				650			
II. A Pennsylvania City Under 100,000 Population.																										
35	Res. A	80	4,000	50	12	38																				
		100	4,000	40	12	28																				
		120	4,000	33	12	21																				
		150	4,000	26	12	14																				
	Res. C	80	3,000	38	8	30	2,400	60	8	52																
		100	3,000	30	8	22	2,400	48	8	40																
		120	3,000	25	8	17	2,400	40	8	32																
		150	3,000	20	8	12	2,400	32	8	24																
45	Res. D	80	3,000	38	8	30	1,800	45	8	37	1,000	50	10	40	1,000	75	16	59								
		100	3,000	30	8	22	1,800	36	8	28	1,000	40	10	30	1,000	60	16	44								
		120	3,000	25	8	17	1,800	30	8	22	1,000	33	10	23	1,000	50	16	34								
		150	3,000	20	8	12	1,800	24	8	16	1,000	27	10	17	1,000	40	16	24								
80	Minor Business	80	2,400	30	8	22	1,500	38	8	30	1,000	50	10	40	1,000	75	16	59	1,000	100	22	78	1,000	125	28	97
		100	2,400	24	8	16	1,500	30	8	22	1,000	40	10	30	1,000	60	16	44	1,000	80	22	58	1,000	100	28	72
		120	2,400	20	8	12	1,500	25	8	17	1,000	33	10	23	1,000	50	16	34	1,000	67	22	45	1,000	83	28	55
		150	2,400	16	8	8	1,500	20	8	12	1,000	27	10	17	1,000	40	16	24	1,000	53	22	31	1,000	67	28	39
III. A Pennsylvania City Over 150,000 population.																										
35	Res. A.	80	4,000	50	10	40	2,500	62	10	52																
		100	4,000	40	10	30	2,500	50	10	40																
		120	4,000	33	10	23	2,500	42	10	32																
		150	4,000	27	10	17	2,500	33	10	23																
45	Res. B.	80	2,500	31	14	17	1,875	47	14	33	1,250	62	14	48	1,250	93	14	79								
		100	2,500	25	14	11	1,875	37	14	23	1,250	50	14	36	1,250	75	14	61								
		120	2,500	21	14	7	1,875	31	14	17	1,250	42	14	28	1,250	63	14	49								
		150	2,500	17	14	3	1,875	25	14	11	1,250	33	14	19	1,250	51	14	37								
100	Res. B. Business	80	2,000	25	14	11	1,500	38	14	24	1,000	50	10	40	1,000	75	12	63	625	62	14	48	625	78	16	62
		100	2,000	20	14	6	1,500	30	14	16	1,000	40	10	30	1,000	60	12	48	625	50	14	36	625	62	16	46
		120	2,000	16	14	2	1,500	25	14	11	1,000	33	10	23	1,000	50	12	38	625	42	14	28	625	52	16	36
		150	2,000	14	14	0	1,500	20	14	6	1,000	27	10	17	1,000	40	12	28	625	33	14	19	625	42	16	26
IV. An Indiana City																										
35	Res. A.	80	2,400	30	8	22																				
		100	2,400	24	8	16																				
		120	2,400	20	8	12																				
		150	2,400	16	8	8																				
40	Res. B.	80	1,000	12	12	0	1,000	25	12	13	1,000	50	12	38	1,000	75	12	63								
		100	1,000	10	12	0	1,000	20	12	8	1,000	40	12	28	1,000	60	12	48								
		120	1,000	8	12	0	1,000	17	12	5	1,000	33	12	21	1,000	50	12	38								
		150	1,000	7	12	0	1,000	13	12	1	1,000	27	12	15	1,000	40	12	28								
85	Res. B. Business	80	600	8	12	0	600	15	12	3	600	30	12	18	600	45	12	33	600	60	13	47	600	75	14	61
		100	600	6	12	0	600	12	12	0	600	24	12	12	600	36	12	24	600	48	13	35	600	60	14	46
		120	600	5	12	0	600	10	12	0	600	20	12	8	600	30	12	18	600	40	13	27	600	50	14	36
		150	600	4	12	0	600	8	12	0	600	16	12	4	600	24	12	12	600	32	13	19	600	40	14	26

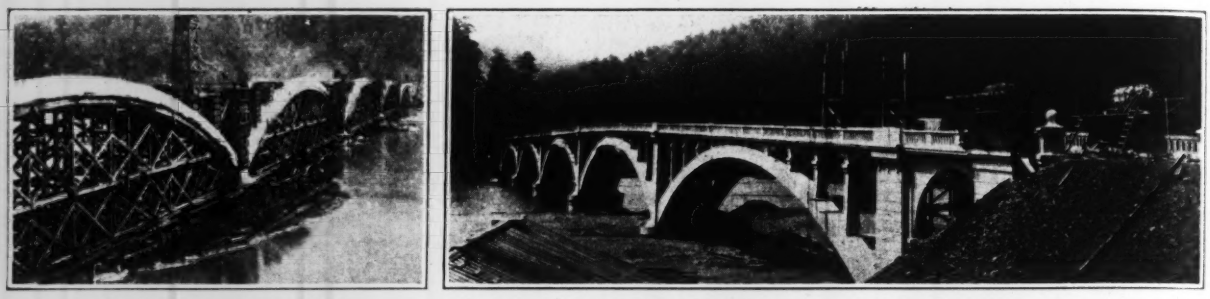
Electrification of Paris-Orleans Ry.

Progress in electrification of the Paris-Orleans railroad to the end of 1926 includes completion of electric service as far as Vierson, power being supplied by hydro-electric works at Eguzon, and work on the Paris-Brives section of the Paris-Toulouse line and on two cross lines, St. Sulpice-Gannat and Brives-Clermont.

Defects in New Concrete Bridge and Proposed Repairs

Arch Ribs and Posts of Klamath River Bridge Badly Honeycombed by Segregation—Patching and Jacketing Recommended

EXTENSIVE defects have been found in a new concrete arch highway bridge over the Klamath River near Requa, in northern California, and since mid-summer have been the subject of investigation, together with study of feasible methods of repair. A board of engineers appointed in July has rendered a report recommending elaborate and costly repairs, involving the patching and jacketing of the main ribs and spandrel posts. The State Highway Commission has concluded to open the bridge to limited traffic pending repair, but heavy traffic is not to be allowed for the present.



KLAMATH RIVER BRIDGE DURING CONSTRUCTION AND AFTER COMPLETION

The structure in question, known as the Douglas Memorial bridge, was built by the State Highway Department of California. It consists of five arch spans of about 205½ ft. (the end spans are slightly longer) and 30 ft. 10 in. rise, of two-rib open-spandrel type. Its general plan was described in *Engineering News-Record* of Sept. 25, 1924, p. 506, and its construction in the issue of June 17, 1926, p. 991. News of the discovery of defects and the appointment of an investigating board was reported Aug. 5, 1926, p. 232. This board consisted of C. E. Andrew, bridge engineer, Washington State Highway Department; Merrill Butler, structural engineer, city of Los Angeles; and Henry D. Dewell, consulting engineer, San Francisco.

The arch ribs were completed in December, 1925. Some of the defective spots were dug out in May and June, 1926, in exploratory investigation of the honeycombed concrete in the arch ribs, and it is reported that at the time of the dedication of the structure, on May 17, curtains were hung over some such holes to conceal them from the visitors' view. However, the true extent of the defects apparently became known only late this summer after close examination and exploratory drilling. This work was done at the instance of the investigating board just mentioned, which board was appointed by the Highway Commission early in July and made its examinations in July and August.

From the fact that another board, composed of contractors, has reported on the contractor's equipment and program of construction, it seems probable that the relations between the state and the contractor were not at all times harmonious, but it is not known whether this condition or the investigation of the contractors' board related to the quality of the concrete.

Location, Extent and Character of Defects—The report of the Andrew-Butler-Dewell board, made under date of Sept. 22, declares the bridge to be "defective to the extent that repairs are urgently necessary if hazard is to be eliminated and the bridge saved from rapid deterioration." The following passages from the report indicate the location and nature of the defects:

> The most serious defects from a structural standpoint are in the arch ribs, and are in the nature of rock and sand pockets and interior surfaces or weaknesses due to lack of bonding between successive "pours" of the concrete. *Certain cross-sections of the arch ribs have from 25 to 30 per cent of their area rendered ineffective* by reason of such rock and sand pockets.

The haunch sections, in general, exhibit the most serious defects. However, defective concrete is not limited to the arch ribs but it occurs also in the columns supporting the roadway and also (but to a slight extent only) in the piers. The concrete in the roadway, beams and girders, on the other hand, is stated to be of excellent quality.

At the board's first inspection it found that work had already been done on the arch ribs in cutting out defective concrete. The interior surfaces of the holes cut out were "of defective concrete, largely rock and sand pockets," indicating segregation of the material during deposition of the concrete and inadequate tamping and working in the forms. The board says of this inspection:

> In addition, there was ample evidence that the contact surfaces of successive "pours" had not, in many cases, been properly bonded. Existing "laitance" along such joints was confirming evidence of the unsatisfactory method of placing and lack of proper bond.
>
> The defective concrete, as evidenced by the rock and sand pockets, was particularly noticeable in the haunch sections, the westerly face of the haunch in the northerly half of the upstream rib of No. 3 span being particularly bad. The concentration of holes from which defective concrete had been removed was particularly noticeable here, and constitutes a zone of weakness which is sufficient to justify apprehension. The fact should be here noted that all defective concrete had not been removed. Those responsible for the cutting had deemed further cutting dangerous to the safety of the bridge. In so exercising caution they are to be commended.

Following this inspection, core drilling was done in the arch ribs to determine the character of the interior concrete. This drilling continued for two months, and holes were drilled in alternate panels of each arch rib except in the crown section, where floor and spandrel wall are cast directly on the ribs, these crown sections being believed less defective.

The cores indicated that the section of the ribs contained layers of good concrete, interspersed with layers of honeycombed and defective concrete. In some cases there was evidence of insufficient sand; in other cases the material appeared to be composed principally of rock. Water, when poured into a drill hole, would travel down through a rib from 10 to 14 ft., to emerge through one of the pockets which had been cut out, and along the surface line of the construction or pouring joints.

> These cores . . . showed that the haunch sections of the ribs contained the greater number of defects and also the most serious defects. Some cores showed as much as 30 to 40 per cent of the core missing, due to the fact that the material was so weak and honeycombed that the drill could not remove it except in small pieces, or that it washed away. The hard concrete found appeared to be of excellent quality.

The board's opinion as to the nature of the defective concrete was confirmed by a report made by Theodore P. Dresser, Jr., chief engineer of the testing laboratory of Abbot A. Hanks, Inc., San Francisco, who reported that:

> The cores indicate that the concrete was undoubtedly mixed with a sufficient proportion of fine aggregate to coarse aggregate, at a medium wet to slightly wet consistency, and should have had a workability that would allow it to satisfactorily fill the forms with care in placing and tamping.

Mr. Dresser says that the porous or gravel pockets "in practically all cases show a tendency to be lens-shaped in a horizontal direction as generally occurs when concrete is improperly placed in a form without proper tamping or care to prevent segregation." He also says, from his examination of the cores, that:

> In general the concrete had been mixed at a medium wet consistency, that the mix had a sufficient proportion of sand to gravel and possibly was slightly over-sanded. In some sections the appearance and texture of the cement matrix would indicate that the batches of concrete were not all poured of the same consistency and that some excessive amounts of water had been used at times.

The board finds that "the prevailing proportion of ingredients was satisfactory," and that "the chief factor in producing the large amount of defective concrete which is shown to exist in the arch ribs was the improper method of depositing, which involved the absence of sufficient mechanical working of the concrete immediately after it was deposited in the forms." It says, further,

> Our conclusions with respect to the concrete are (1) that the materials of which it is composed are satisfactory, (2) that the proportions in which it was mixed were satisfactory, (3) that too much water was present in the mix much of the time, (4) that the sand and rock separated from the mix when the concrete was deposited in the forms during a considerable portion of the time it was being placed and (5) that in general the concrete after deposition in the forms was not sufficiently tamped, spaded, or otherwise mechanically worked to give a consistently homogeneous resultant concrete.

Proposed Repair—From a review of the design the board finds that the arches were designed for a maximum stress of 800 lb. per sq.in., and reports the design to be safe and conservative. The concrete as called for should have had a minimum ultimate strength of 3,000 lb. per sq.in. The board does not express any opinion on the strength of the bridge in its present condition, except in so far as it approves allowing "limited" traffic to cross the bridge. It says, however, that serious deterioration on account of the defective and porous concrete is likely to occur, especially because of the location near the ocean, where salty fogs occur, which condition is "particularly favorable to rusting of the steel reinforcement."

The only method of repair that would give the full intended strength is "complete removal of the arch ribs and their replacement in good and sound concrete." This is estimated to cost from $125,000 to $150,000. As a cheaper method of repair the following procedure is recommended: (1) Filling all existing cavities and applying pressure grouting and cement-gun deposition when necessary; (2) roughening the surfaces of the ribs and cutting keyways to bond the jacket concrete; (3) rounding off the corners of the ribs; (4) jacketing the ribs with a reinforced-concrete casing, this final step to be followed by a load test of the repaired structure. Such repair is estimated to cost $50,000, and is expected to give a result that will be as safe against deterioration as possible without renewing the ribs, and safe for a reasonably heavy traffic, but not of the capacity intended under the contract. It is recommended that the posts be similarly filled and jacketed.

Mere filling of the defective spots with sound concrete (either by pouring or by gun deposition) after cutting out the defective material is not considered satisfactory by the board because of shrinkage during setting and because it would not take care of the danger of deterioration due to porous concrete. Accordingly, it is recommended that an impervious covering be added to the present ribs and posts, with effective bond between the two.

The bridge was designed and built under the supervision of the California Highway Commission. F. Rolandi, San Francisco, was the contractor. The commission has made public announcement of the fact that in its present condition the structure is safe for ordinary loads and thus is available for limited use while the work of strengthening it is under way. It states that a portion of the $70,000 held out of payment to the contractor by the state will be used to pay for the repairs.

Schedule of Engineering Salaries at Toledo, Ohio

A new salary schedule for salaries and positions in the Division of Engineering and Construction and the Division of City Planning of Toledo, Ohio, was established recently by ordinance as follows:

DIVISION OF ENGINEERING AND CONSTRUCTION:	
1 Commissioner, per mo.	*$300.00
1 Chief clerk, grade B, per mo.	175.00
2 Senior clerks, grade C, ea. per mo.	150.00
1 Superintendent of construction, per mo.	190.00
1 Sidewalk supervisor, per day	7.50
1 Structural engineer, per mo.	250.00
1 Sanitary engineer, per mo.	250.00
1 Paving and office engineer, per mo.	225.00
Construction engineers, ea. per mo.	200.00
Senior assistant engineers, each per day	7.50
Junior assistant engineers, each per day	6.50
1 Chief draftsman, per day	8.00
Draftsmen, grade A, each per day	7.50
Draftsmen, grade B, each per day	6.50
Assistant draftsmen, each per day	6.00
Instrument men, each per day	6.00
Rodmen, grade A, each per day	5.50
Rodmen, grade B, each per day	5.00
Chainmen, each per day	4.50
Axemen, each per day	4.00
Senior construction inspectors, each per day	6.00
Junior construction inspectors, each per day	5.50
CITY PLANNING:	
1 City plan engineer, per mo.	$300.00
1 Senior clerk, grade C, per mo.	150.00
1 Draftsman, grade B, per day	6.50

* Subsequently increased to $6,000 a year

Building Small Concrete-Lined Earth Reservoir

Dragline and Caterpillar-Hauled Wagons for Earth Moving—Concrete Poured by Shovel from Embankment—Novel Overflow

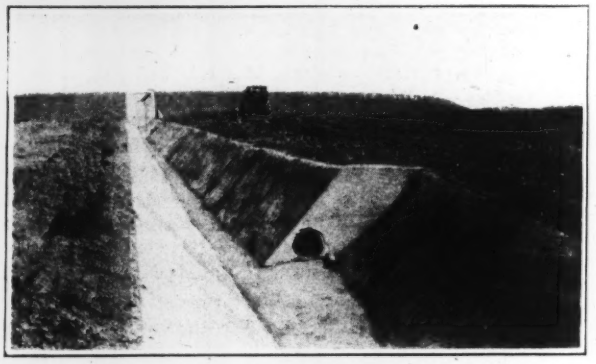
By J. P. Bailey
Assistant Engineer, Florence Creek Soft Water Project, Oneida, N. Y.

EXCAVATION and fill for the recently completed 14-m.g. service reservoir for Oneida, N. Y., was done by a gasoline dragline equipped with a 1-yd. bucket discharging into dump wagons hauled by 5-ton crawler tractors. Concrete for the bottom lining was mixed in 5-bag batches by a paver. For the bottom, the paver discharged the concrete in place but for the side slopes, the paver for these being at the toe, the paver discharged into a 1-yd. bottom-dump bucket operated by a locomotive shovel on the bank, as shown in the view. Further details of the construction work and a note on the unusual reservoir overflow are given further on.

In plan the reservoir is 230 x 230 ft., with semi-circular ends having radii of 115 ft. The embankment is 20 ft. wide on top, with both slopes 1 on 2, a total depth of 19 ft., and a maximum water depth of 16 ft., maintained by the overflow already mentioned, which is at one of the ends, and has the dimensions and lining given in the subcaption to the view. The inlet pipe has a diameter of 18 in. and enters the reservoir on a skew at the bottom level in the middle of one side. The material excavated was a red clay-like formation, approaching shale characteristics at various places near the bottom. The site sloped slightly. Depth of excavation varied from 4 to 12 ft. and height of embankment from 7 to 15 ft., the highest fill occurring at the point of closure. The excavation was stopped to avoid hard shale, which in places was less than 1 ft. lower.

Ordinarily one dragline excavator would keep three tractors busy, each hauling two wagons. An average good day's work was about 600 yd., but due to rains and breakdowns some six months were taken to move 32,000 yd. This carried the excavation into early November, whereas the contract called for the completion of the lining by Dec. 1. Postponement of concreting until after cold weather was granted to the contractor. This gave opportunity for further settlement of the embankment. The side slopes were lined first. In 14 days of actual paving over 1,100 cu.yd. of concrete were placed. The bottom pouring, of about the same volume, took ten working days. The side slabs were 6 in. and the bottom slabs 4 in. thick, both of 1:2:4 concrete. The only reinforcement used was a single layer of wire mesh (28 lb. per 100 sq.ft.) in the upper 10 ft. of the slope, and the same material carried nearly to the bottom for the 60 ft. where closure was made and the concrete placed on fresh fill.

PLACING SLOPE CONCRETE, ONEIDA SERVICE RESERVOIR
Concrete mixed in paver, discharged into 1-yd. bottom-dump bucket on shovel running on top of bank and poured on slope. For the bottom lining, the mixer was moved about and discharged directly on the subgrade. Note paver at foot of slope, and alternate slab paving plan.



CONCRETE-LINED OVERFLOW FROM ONEIDA RESERVOIR
Notch-shaped channel across top of bank holds water 3 ft. below top of bank. Channel continues down outer slope and then for 400 ft. to a gulley. Channel 2 ft. wide at bottom, slopes 1 to 1, depth 3 to 5 ft., lined with 1 ft. of concrete to foot of outer slope, and 6 in. from there to end. Expansion joints about 20 ft. apart. Pipe in foreground is for draining sediment from reservoir bottom.

ITEMIZED CONTRACT COST, 14-M.G. CONCRETE-LINED EARTH RESERVOIR, ONEIDA, N. Y.

Item	Price	Amount
Excavation, 33,740 cu.yd.*	$0.80	$26,992
First class concrete, 2,397.86	13.50	32,371
Second class concrete, 21.8	13.50	294
Gatehouse, complete	1,000.00	1,000
Hauling c.-i. pipe, specials and valves, 68.15 tons	4.00	273
Laying 16- and 18-in. c.-i. pipe, specials and valves (furnished by city), 1,037 ft.	1.00	1,037
Furnishing and placing one 12-in. single-acting Ross altitude valve	500.00	500
Fencing, 6-ft. anchor post and wire, 1,484 ft.	1.35	2,003
Furnishing and laying vitrified pipe, 386 ft.	0.40	154
Structural steel, 1,250 lb.	0.12	150
Wrought-iron pipe railing, 60 ft.	2.00	120
Gravel for 1,000 ft. of highway to reservoir, 272.2 cu.yd.	3.00	817
Contract total		$65,711

*Including the saving of top soil, spreading it on top and slopes of embankment and seeding. Excavation from the reservoir site totalled 32,000 cu.yd. The total includes 1,000 ft. of gravel road leading to the reservoir. The remaining 1,740 yd. were from the new highway, overflow ditch trench, etc.

The concrete was poured in alternate strips about 10 ft. wide, running the entire 42-ft. length of the slope and the bottom concrete was poured in alternate rectangles, about 22 x 60 ft., the latter for convenience, as with the bottom always submerged a monolith would otherwise have been all right. Elastite was used in all the joints and all the side slabs were finished with a 1-in. mortar coat.

On behalf of the city, the writer was assistant engineer in charge of construction and also assisted in the design of the reservoir, under Fred J. Wagner, chief engineer. The contractors were Provo Brothers, Syracuse, New York.

Dredging Projects to Improve the Panama Canal

Slides and Maintenance Work Require a Dredging Fleet Which Is Used to Good Advantage During Spare Time

By R. Z. Kirkpatrick
Chief Hydrographer, Panama Canal, Balboa Heights, C. Z.

In the early days of Panama Canal operation three of the biggest dipper dredges in the world, the *Gamboa*, the *Paraiso*, the *Cascadas*, were purchased. There was considerable original excavation yet to do, and the menace of slides was then a real problem. These dredges, with their interchangeable 15- and 10-yd. dippers, together with the Canal's auxiliary fleet, consisting of drill and spoil barges, tugs, ladder, pipe-line suction and bucket dredges, have done work during the past 12 years that is world-famous.

The policy of keeping an efficient dredging force, so as to be able to attack the occasional slide with vigor and dispatch, was adopted as an insurance policy, as it were. It was known that there would always be some maintenance work on channels and harbors, and as traffic became heavier, new work on capital charge would likely come up. It seems wise therefore to have improvement projects planned ahead, as fill-in jobs, to keep this organization busy. Hence, paralleling an annual maintenance allotment of $300,000 to $500,000 for dredging, a project program likely to cover 20 years and cost upward of $16,000,000 is being carried out, each job being done in the order of its apparent need.

Already three projects are finished, consisting of two small cutoffs of banks at channel bends above and below the Pedro Miguel and Miraflores Locks, and a $2,000,000 channel-widening project at the La Pita Bend. Likewise nature has advanced considerably the progress on another, the project at Lirio, which became involved in a slide movement in October, 1923, and was quickly removed by a concentration of equipment, without hindrance to shipping traffic.

The builders of the Canal looked well ahead in determining the existing dimensions of the Gaillard Cut at

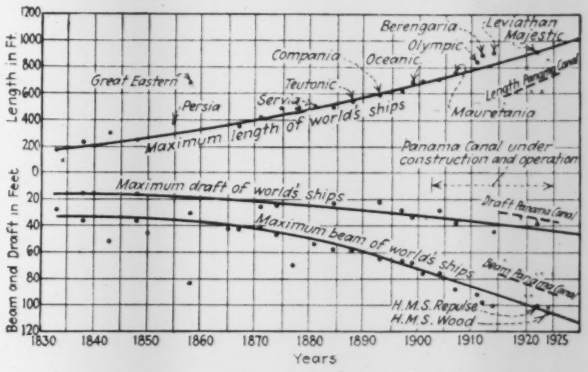


FIG. 1—TREND IN SIZES OF VESSELS USING PANAMA CANAL

Compared with the largest merchant vessels using New York Harbor.

not less than 300 ft. wide. The long turns provided at tangent points were ample, and are even now under ordinary circumstances. But the accompanying study of the lengths, beams and drafts of the world's merchant marine shows an ever-present trend to larger ships. This tendency exists in the shipping that uses the canal (see *Engineering News-Record*, March 12, 1925, p. 447). Two British battleships, the *Hood* and the *Repulse*, 105 ft. 2½ in. and 102 ft. 8 in. in beam, respectively, transited the Canal in 1924. But it is confidently believed that the Washington Naval Conference and the cessation of commercial rivalry in European shipping circles, coupled with the uneconomical use of mammoth merchant vessels in world's trade, will greatly flatten the curves during the next 30 years.

At any rate there are several (either in process or projected) dredging projects begun in 1924, which will

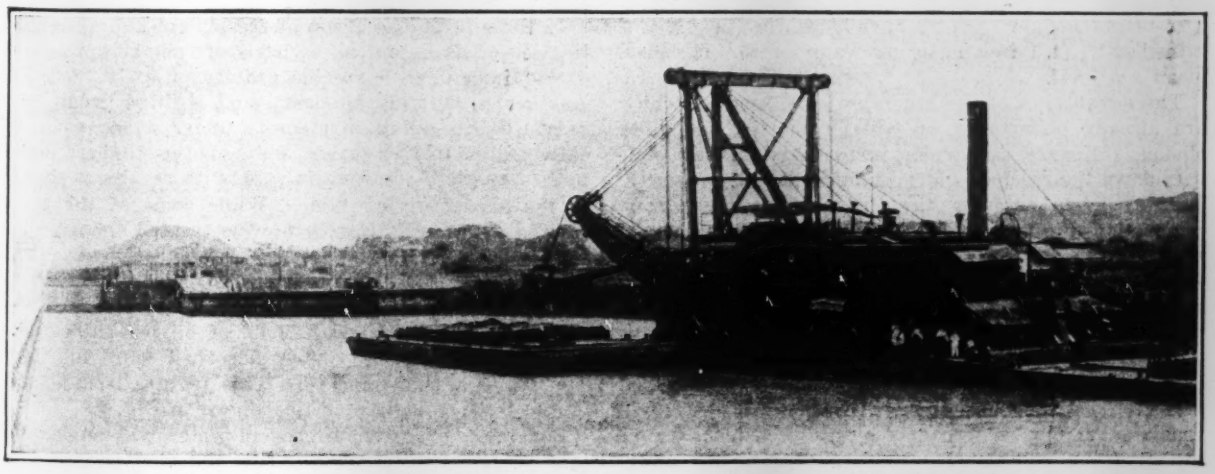


FIG. 2—DREDGE "PARAISO" ON IMPROVEMENT PROJECT AT PACIFIC ENTRANCE OF PANAMA CANAL

make the canal easier and more quickly transited—especially so in looking forward to the days of heavier use of the canal and to 24-hour a day traffic requiring night transiting.

One of the projects was practically that of maintenance, and has been virtually completed with one dipper dredge. It involved cleaning up the 9-mile cut to a depth of 45 ft. (at Gatun Lake level of 85 ft. above the sea), about 1,200,000 cu.yd. of mixed materials. Some of this was capital charge, as not all of it had been cut to the full depth during the actual construction of the canal.

The project in the sea level section on the Pacific side will take about 7 years. It consists of removing 6,100,000 cu.yd. from 8 nautical miles of channel, and 2,000,000 cu.yd. from Balboa Harbor, to 50 ft., below mean tide, the depth of the lower sill at Miraflores Lock. This project has been under way for about two years, most of the time with one dipper dredge on a 16-hour schedule. Depths have heretofore been maintained at 37 ft. below mean low water or 45.3 ft. below mean sea level.

The advantages of the other projects, some of which are already undertaken or will be shortly, are quite obvious. Longer and wider turns and longer visibilities down the reaches, wider channels at lock entrances, more room in entering the Cristobal docking areas, removal of high spots in Limon Bay anchorages, all speak for themselves for efficiency and safety in handling the traffic. And while working on them the equipment is ready to be shifted to emergency work in a very short time. No traffic delays of any moment have occurred for many years; relatively small slides have been encountered, and these usually outside of the canal prism. It is therefore expected that the projects will progress rapidly, delayed only by the occasional use of the dredging equipment when it is taken for emergency work.

Treated Douglas Fir Ties Show Strength Unaffected

Ties Seasoned and Treated in Different Ways Give Good Results in Tests—Incisions Increase Oil Absorption

RECENT tests of treated ties of Douglas fir (or Oregon pine) indicate two important points: (1) Oil-seasoning and creosoting do not reduce the strength of the timber, and (2) incising or puncturing the surface by toothed rollers increases the penetration of creosote oil in this dense timber, while hardly affecting the strength of the wood in compression perpendicular to the grain. The tests were made under the direction of R. H. Rawson, consulting engineer, Portland, Ore., and were reported by him in a paper for the American Wood Preservers' Association.

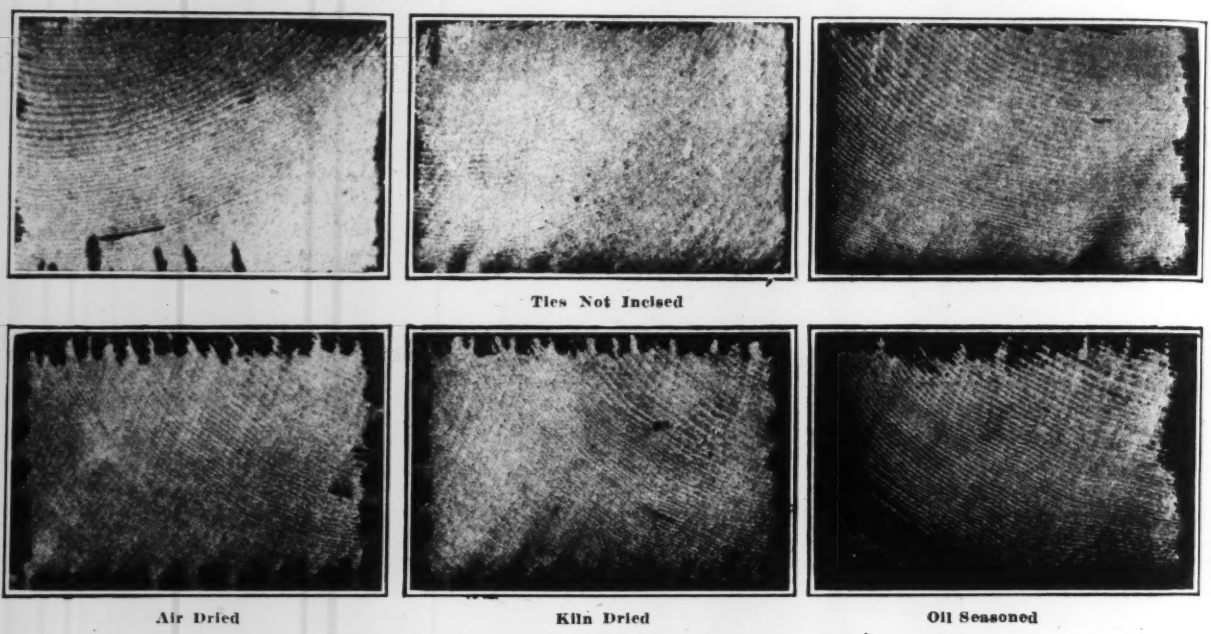


FIG. 1—CREOSOTED DOUGLAS FIR TIES
The deeper penetration of oil due to puncturing the surface with toothed rollers is shown by the bottom row of sections.

In these tests, one group of freshly cut and untreated ties served as a control, or basis of comparison. This green timber had a specific gravity of 0.477 to 0.481. Another group was air-dried, and a third group was seasoned by boiling in creosote under a vacuum. In each of the three groups half of the timbers were incised and half were not incised, with results as shown in the accompanying table. While some of the tests showed a greater strength for the treated timber, this is attributed to the variability of the wood structure in individual pieces or specimens. Oil-seasoned timber, incised and not incised, although not subjected to pressure, absorbed 2.74 and 3.28 lb. of oil per cubic foot, respectively. Incised timber absorbed more oil than that which was not incised. This feature is indicated by the sections of treated ties shown in Fig. 1.

Soaking the treated timber in water was an important feature of the test. After the first test on the treated specimens, these sticks were put in a tank and

soaked until they had reabsorbed sufficient water to bring the moisture content above the fiber saturation point. In this way the specimens were brought back to their weakest condition in order to compare them with the green not-incised specimens which formed the control. The relation between moisture content and the compression strength perpendicular to the grain of the wood is shown by the curve in Fig. 2.

All creosoting was done by the Rueping (empty-cell) process. The treated specimens were subjected to air pressure reaching 100 lb. per sq.in. in 50 minutes, and a maximum oil pressure of 136 to 145 lb. in 30 minutes. The maximum temperature during the pressure period was 195 deg. F., increased to 216 deg. in 80 minutes after the pressure was released, followed by a 25-in. vacuum for two hours. Oil-seasoned specimens were boiled in oil, using a maximum temperature of 192 deg. F. under a minimum vacuum of 23 in.

EFFECT OF INCISING ON TREATMENT AND COMPRESSION STRENGTH IN DOUGLAS FIR TIES

	Timber Condition	Creosote Absorption, Lb. per Cu.Ft.	Moisture Content Per Cent	Compression Perpendicular to Grain Crushing Strength at Elastic Limit, Lb. per Sq.In. As Tested	Adjusted for Moisture	Water Soaked as Tested	Ratios in Per Cent of Green Strength Adjusted for Moisture	Water Soaked
1	Green (control)	....	31.37	407.88	....	.....	100.00	.....
2	Green incised (control)	....	30.28	397.76	.....	.....	97.52	.....
3	Not incised; air dried	....	22.90	433.22	406.11	.....	99.57	.....
4	Not incised; air dried, treated	5.26	22.23	472.41	428.65	451.95 at 23.00° C	105.09	104.00
5	Incised; air dried	....	22.54	426.85	392.91	.....	96.33	.....
6	Incised; air dried, treated	5.70	21.44	448.35	394.63	434.54 at 24.56° C	96.75	106.54
7	Not incised; oil seasoned	2.74	27.49	401.84	.....	.....	98.52	.....
8	Not incised; oil seasoned, treated	4.45	28.43	422.58	.....	399.68 at 33.47° C	103.60	97.99
9	Incised, oil seasoned	3.28	28.01	433.06	.....	.....	106.17	.....
10	Incised, oil seasoned, treated	6.38	27.30	440.38	.....	410.02 at 36.07° C	107.97	100.52

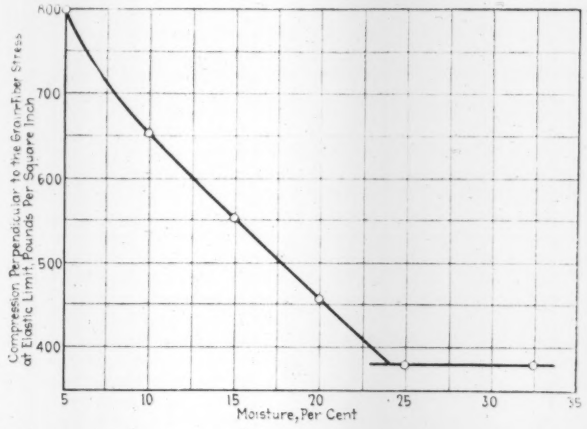


FIG. 2—RELATION OF STRENGTH TO MOISTURE CONTENT

Conclusions—It is considered evident from these tests that the present methods of oil seasoning and creosoting do not weaken Douglas fir. Incising the faces of the timber permits a deeper and more uniform penetration of the creosote oil and affects to a negligible extent the strength in compression perpendicular to the grain.

Jetty Construction at Lake Worth

Conflicting statements appeared in the article entitled "Jetties of 5- to 10-ton Precast Blocks Constructed in Florida," on p. 1030 of the Dec. 23 issue, in regard to credit for the design of the jetties. The statements that the contractor was the designer are in error. Karl Riddle, president Riddle Engineering Co., designed the jetties as stated in the last paragraph of the article.

Interest During Construction Not a Capital Charge for Taxes

THE United States Board of Tax Appeals, in the case of the Spring Valley Water Co. (California) against the Commissioner of Internal Revenue, has ruled that "Interest paid by a water corporation on borrowed funds used in the construction of a dam may not be included in the cost of the dam in determining the amount deductible as a loss upon its destruction."

Between the years 1913 and 1918, the Spring Valley Water Co. was engaged in building a dam on Calaveras Creek in Alameda County, Calif., out of funds borrowed by it for general corporate purposes. At the end of each month the company computed interest on the amount expended in the construction of the dam and charged the amount thus determined to the dam construction account. The interest so computed amounted to $38,224.51 for the years 1913, 1914 and 1915. This amount was deducted by the company from its gross income return and was allowed by the commissioner.

On March 24, 1918, a slide occurred at the dam whereby a considerable part of it was destroyed and lost to the company without compensation. In its income tax return for the year 1918 the company deducted from its gross income the sum of $460,000, representing the amount of its alleged loss sustained through the destruction of the dam. The commissioner, in auditing the return, increased the net income by the sum of $38,224.51 by disallowing its inclusion in the loss.

The board stated in its opinion that "The sole question for decision is whether the petitioner may include as a part of the loss sustained by the destruction of a dam the interest paid on the borrowed funds used in its construction, the interest having been claimed and allowed as deductions from gross income in prior years as interest paid." As bearing upon the case the board quoted from a decision of the U. S. District Court, E. District, New York, in the case of *Westerfield v. Rafferty*, in which the court said in part: "This leads us to consider what these taxes were and what this interest was. To be sure, they are often called 'carrying charges,' and it goes without question that, in fixing a selling price, most business men include these charges and many other expenditures. * * * Yet taxes and interest, when properly defined, do not really represent anything paid into the capital investment."

The Spring Valley Water Co. maintained that this decision did not apply in this case as the company is required under the California law to capitalize interest during construction. However, the Board of Tax Appeals maintained that the decision of the U. S. District Court did apply because it held that "Interest does not represent anything paid into the capital investment."

City Invites Gratuitous Service in Designing Bridges

City of Buffalo Asks Engineers to Prepare Free Preliminary Designs—Appropriation to Pay for Service Refused

AN UNUSUAL procedure in engineering work has been resorted to by the city of Buffalo in its contemplated construction of several bascule bridges. Consulting engineers have been asked to prepare free preliminary designs for these bridges, from which a preferred design is to be chosen by the city engineer. The invitation does not promise (or appear to contemplate) subsequent professional engagement of the author of the preferred design, though the adoption of a design protected by patent will involve the payment of royalty by the city. Information on the construction costs of the several designs or on patent royalties is not called for. The invitation for bridges is:

LETTER OF INVITATION TO ENGINEERS

In the matter of the Bailey Ave. bridges over the improved channels of Buffalo River and Cazenovia Creek, about which you are no doubt partially informed, it is now proposed that we ask for free preliminary designs from the leading bascule bridge designers, from which preliminary designs a preferred design will be chosen.

After the design is selected by the city engineer, it is proposed that we proceed, as soon as possible, with the final plans and details. These final plans and details will then be submitted for bidding purposes.

In connection with these bridges we are sending, under separate cover, 3 blueprint sheets of general plans showing grades, clearance, borings, width, etc. These preliminary plans are for general information and are subject to modification so as to insure the best possible design.

As these bridges are practically at the entrance to a parkway the designs should present an esthetic proposition.

General Description—It is proposed that a bascule bridge be constructed across the improved channel of Buffalo River, and a fixed bridge across the Cazenovia Creek channel. The steel design of each should conform somewhat to one another. Both bridges shall be classified as bridges carrying a highway traffic of exceptionally heavy load units, without street car tracks.

On the fixed bridge over Cazenovia Creek, it is proposed that provision be made for a 48-in. water main and for three 16-in. and two 8-in. gas mains. This fact may require a separate truss to care for the water and gas mains. The water and gas mains across the Buffalo River shall be cared for by submarine methods.

Both bridges are across streams which carry ice floes during spring freshets. Maximum flood flow in Buffalo River is 22,000 sec.-ft. and in Cazenovia Creek 12,000 sec.-ft.

Specifications—So much of the final report on specifications for design and construction of steel highway bridge superstructures as reported in the *Proceedings* of the American Society of Civil Engineers of March, 1924, as pertain to these structures will be considered in your design. As these specifications pertain to fixed bridges they will be supplemented by standard specifications for lift spans.

Sub- and Superstructure—The preliminary design, and later the final, will include both the sub- and superstructures of both bridges. After the selection of the design by the city engineer and final plans made, it is our intention then to advertise the sub- and superstructures separately; that is, the substructure for both bridges and the superstructures for both bridges.

In making a comparison and selection the following are some of the points which will be considered:

(a) With each design submitted we ask for the advantages and disadvantages of the type submitted.

(1) General excellence of the design, simplicity of construction and operation and the adaptability and suitability of the design to the conditions as a whole.

(2) Dependability and stiffness of the bridge under traffic and under operating conditions.

(3) Accessibility and replaceability of all wearing and moving parts, especially those most susceptible to wear.

(4) Advantages and disadvantages of operating mechanism.

(5) Rapidity and facility of operation.

(6) Liability to injury in case of accident or if struck by a vessel.

All preliminary designs shall be submitted on or before Jan. 15, 1927.

If there is any further information desired we will, if possible, gladly furnish it.

JOHN T. MOCKLER, Assistant Engineer Department of Public Works, Buffalo, N. Y.
C. E. P. BABCOCK, City Engineer.
Nov. 15, 1926.

In order to clear up certain matters not fully explained in this invitation, *Engineering News-Record* wrote the city engineer suggesting a number of questions. The pertinent parts of the letter are:

Nothing is said as to engagement of engineer, nor is any provision made for awarding any returns to the author of the design whose type is selected, or to other designers. No assurance is given to the unsuccessful author that parts of his design may not be used, or to the successful author that his design may not be changed.

The invitation asks for preliminary designs, which under the circumstances would have to be quite thoroughly worked out, no doubt, in both structural and mechanical features. Accompanying bids are not asked, and no provision is made for ascertaining the cost of the work, but on the basis of the preliminary designs a particular type is to be chosen by your office as best.

We realize that the field of movable bridges is deeply involved in patents. Possibly it is your primary idea to obtain sketch designs of the application of particular proprietary bridge types to your specific location, but if this is the case it is rather different from the impression conveyed by the form of invitation as it came to our attention.

The city engineer's reply was:

Editor, *Engineering News-Record*,
New York.

Replying to yours of Dec. 16 in relation to the invitation extended bridge designers to submit preliminary designs for bridges to be built in Buffalo:

We agree with you that this is an unusual form of procedure. There were exceptional circumstances by which we were required to enter into this program. After a consultation with our engineers, we asked for an appropriation adequate to reimburse bridge designers for preliminary plans. This was not allowed. Therefore, the next step was to ask a number of bridge designers to submit preliminary plans.

It must be understood, in this connection, that there is no competition, except as to the adequacy of the design to meet local conditions, which will be determined by the Bureau of Engineering.

It is our intent, after selecting the design, that we would advertise for competitive bids for the construction of the particular design.

In asking for bridge designers to submit a design it was not considered at all competitive.

As you suggest in your letter, it is our primary idea to obtain sketch designs of the application of a type, which may or may not be covered by patents, for our location.

It is to be regretted that some of our correspondence with bridge designers may have implied that an estimate of the cost of construction should be considered in submitting a design.

Because of the unusual conditions, our opinion of these facts relating to the course which we pursued in making the invitation for professional engineering information should be published, and if you please you may publish it as coming from the city engineer.

Department of Public Works, Buffalo, N. Y., Dec. 22, 1926.
C. E. P. BABCOCK, City Engineer.

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Credit to the Assistants

Sir—I have read with much interest Mr. Stillwell's letter, in your issue of Dec. 16, regarding recognition of the engineer, and your own editorial comment, and if I may be permitted to say so, I think you both fall short of the point in the matter of remedying the situation.

I do not see in Mr. Stillwell's letter mention of any other engineers' names than those of Colonel Wilgus and George A. Harwood, and one can not tell from the letter that the latter was an engineer. Did Colonel Wilgus do it all himself with a gang of waterboys to help him, or were there other human beings on the job that are generally described as "engineers"? Sometimes there are several such creatures on a big job, and fully as capable as the one in charge.

I do not believe that Mr. Waldron had any intention of slighting or belittling anyone, but was simply following the custom that has prevailed as far back as the history of man goes of mentioning this important piece of work as having been carried out in the reign of a Pharaoh, a Caesar, or a king. I don't believe the intelligent public thinks, after reading Mr. Waldron's article, that President Newman built the Grand Central Terminal any more than intelligent engineers think that Colonel Wilgus did it all by himself.

Engineers carry the germ of their own destruction within them, and that germ is the feeling that works to prevent them from "selling" themselves, their services, and their professions to the public in the only way possible, which is publicity.

I have before me at this moment a report on Construction Plant, Methods and Cost of The Miami Conservancy District, by Charles H. Paul, chief engineer. From cover to cover of the report not a single name of any of his assistants is given. This was a job known over the entire civilized world, and where even the mention of the names in this report of the engineers and the positions they held would have been a hundred times better for future use than a letter of recommendation for the majority of them.

So far as Colonel Wilgus is concerned, his name is sufficiently well known for him to outlive the slight noted by Mr. Stillwell, if it be such. It is much more to the point however, to know to what extent he gave publicity to his assistants at a time when he could, and when to them it meant bread and butter, clothes, money to pay the rent, buy automobiles, social position, power, or whatever they were striving for.

All technical reports should carry the names of the engineers who gave valuable assistance in pushing the projects through to successful completion. The younger engineers should rally to and support their seniors at all times, and the seniors, who act as the mouthpiece for all, should not neglect any opportunity to give public recognition and commendation to others besides themselves when it is deserved.

Dayton, Ohio,
Dec. 21, 1926.

E. O. KEATOR,
Civil Engineer.

Circular Slide Rules

Sir—On p. 978 of the Dec. 9 issue you describe a circular slide rule with a 30-in. scale manufactured by Fowler & Co., Manchester, England. It may be of interest to know that in 1883, before the straight slide rule was in use, M. E. Yeatman, then bridge engineer of the Pittsburgh, McKeesport & Youghiogheny R.R., showed the writer a circular slide rule 10 in. in diam. which he had constructed of cardboard in imitation of one of metal he had seen in Liverpool. A copy of this was made by the writer and by others of the office and used on monthly estimates with a very considerable saving of time. It is still in his possession.

KENNETH ALLEN,
Sanitary Engineer, Board of Estimate and Apportionment.

New York City,
Dec. 10, 1926.

Theoretical Energy Losses in Intersecting Pipes

Sir—Once more the type has gone wrong in the correction of the formulas in the article "Theoretical Energy Loses in Intersecting Pipes." *Engineering News-Record*, July 22, 1926, p. 140. Those who keep bound copies should note these changes, and disregard the correction misprinted in my letter in the issue of Dec. 16, 1926, p. 1009.

The real corrections are as follows: One—in the sixth line up from the bottom of the first column

$$\left(\frac{q_n}{g_n}\right)^2 \text{ should be } \left(\frac{q_n}{a_n}\right)^2$$

Two—In equation (9)

$$\left(1 - \frac{V}{v}\right) \text{ should be } \left(1 - \frac{V}{v}\right)^2$$

FRANK S. BAILEY,
With Metcalf & Eddy, Contracting Engineers.

Boston, Mass.,
Dec. 22, 1926

Submerged Contact Aerators Not New

Sir—In his article on "Submerged Contact Aerators" in your issue of Dec. 11, p. 948, Dr. Imhoff might well have elaborated a little more on the preliminary work done by others in this country. Not only were contact aerators built by Black and Phelps in connection with their experiments on treatment of sewage for discharge into New York Harbor, but they were experimented upon in the upper part of a tank in Boston, at the Massachusetts Institute of Technology they were tried at the Brooklyn Testing Station by Ford and Hammond around 1913 and 1914. Contact aerators were also used by Harry Clark from 1912 on in various shapes. In fact, Harry Clark circulated sewage through the aerators.

Some estimates made in a preliminary way by the Sanitary District of Chicago seem to indicate that the cost of such aerators may easily run as high as $7,500 per million gallons daily capacity aside from the cost of air compressors, piping or other plant. Dr. Imhoff does not state what degree of treatment can be obtained by using 0.1 cu.ft. of air per U. S. gal. Curiously enough, that amount of air is about the same as the maximum indicated by Phelps as required for his work. The power consumption noted seems low. I am unable to obtain from Dr. Imhoff's article any other statement of results obtained except that with strong sewage the biological purification was more than half. Just how this is measured is not exactly shown. I note that the article in question gives the permanganate oxygen consumed. It is too bad that this was not put on a biological oxygen consumed basis, as we have found the latter, as a means of test, far superior to the permanganate oxygen.

With reference to partial purification, from our experience on aerators, the argument made under conclusion 1 is hardly tenable, in that we do find the power consumption is much less for partial than complete activation from the experience at Birmingham and at Decatur, Ill. The Decatur experience is, of course, out of the ordinary because of the extreme strength of the sewage, so that figures as to the amount of air used and power are not an indication of ordinary experience. Power discussions as between different countries or activated-sludge works have proved rather unsatisfactory.

Under conclusion 2, on preliminary treatment, the detail would be more valuable if some actual experience could be given.

In conclusion 3, relating to city sewage with certain kinds of troublesome industrial wastes, the statements are rather broad, because there seems to be no question that such aerator apparatus as evidenced by activated sludge as well as trickling filters, are disturbed by paint wastes or other material of that type. I see no inherent virtue in the contact aerator which would avoid the difficulty that either a trickling filter or activated-sludge plant would have in meeting extraordinary demands upon it that way.

I regret that the article did not state the size of the plants which Dr. Imhoff is operating with this device, giving the population, million gallons handled per 24 hours, period of contact and period of settling, before and after. Further, the article should have made clear that its conclusions were

drawn from experience derived under German conditions; and that in order to make it applicable in the United States and learn the limitations of the apparatus, tests here will be required.

LANGDON PEARSE,
Sanitary Engineer, Sanitary District of Chicago.

Chicago, Ill.
Dec. 12, 1926.

[In order to include the foregoing letter in the half-yearly volume of *Engineering News-Record* it is being printed at once, but opportunity will be afforded Dr. Imhoff to reply to Mr. Pearse early next year, if the former so desires.—EDITOR.]

Private Toll Bridges and Toll Refunding

Sir—I am very much surprised at your editorial of Dec. 2 supporting the resolutions adopted by the Association of State Highway Officials, relative to toll bridges. These resolutions are so narrow and so lacking in a vision of future benefits to the users of the highways and to the public in general that they seem to have been inspired by other reasons than those given for their adoption.

In most toll bridges it is a question either of the bridge being built by private capital, or of no bridge at all. If you discourage the building of toll bridges by private capital in instances where the states are not prepared to build them, you are discouraging progress. It makes no difference to the man who must pay toll whether he pays the toll to a city, county, state, or a corporation, but it makes a considerable difference to the tax payers if, when taxes are already high, they are increased in order to build a bridge which will only be used by a portion of the tax payers. It seems to me that it would have been more consistent with your usual progressive and wideawake policy had you strongly condemned the resolutions of the Association of State Highway Officials as a step backward, rather than approve them as a step forward. These resolutions may be, as you state, "courageous" measures, but they are courageous only because they advocate a condemnation of business enterprise to the detriment of adequate and convenient highway service.

J. E. GREINER,
Consulting Engineer.

Baltimore, Md.,
Dec. 7, 1926.

Sir—I notice on p. 897 of *Engineering News-Record* for Dec. 2, an editorial headed "Toll Bridge Reform." Following a description of the Bear Mountain Bridge franchise I find, at line 23 of the second column, these words "So far as we know this sound principle has not found adoption elsewhere."

Permit me to call your attention to Chapter 379 of the Laws of the State of New York for 1922. The Buffalo and Fort Erie Public Bridge Co. is by this act authorized to construct a toll bridge over the Niagara River between Buffalo, N. Y., and Fort Erie, Ont. This bridge is under construction and will be completed in May or June, 1927. Section 16 of Chapter 379 provides that eventually this bridge shall become the property of the State of New York and the Dominion of Canada. In my opinion this transfer of title should take place within the next ten or fifteen years.

WM. RUSSELL DAVIS,
Consulting Engineer.

Albany, N. Y.,
Dec. 14, 1926.

[Sec. 16 of the act mentioned provides for reversion to the state or such municipality or agency of the state as may be directed by the legislature, of that part of the bridge located within New York, and to a corresponding Canadian public authority of the Canadian part, "when the corporate obligations of the corporation shall have been paid and its capital stock shall have been retired in the manner prescribed in its bylaws." No provision for retirement, limitation of dividends or the like is made or implied by the act, however.—EDITOR].

Sir—I have read with interest the editorial comment on toll bridges in the Dec. 2 issue of *News-Record*.

A provision similar to that of the franchise of the Bear Mountain bridge has, I believe, been adopted in the case of the bridge which is being built at Mobile, Ala. In this case the bridge will be privately financed at a cost of about two and one-half million dollars, approximately one-half of which represents second mortgage bonds raised in Mobile. The bridge will be leased to Mobile County for operation for a period of thirty years, the county undertaking the upkeep of taxes, insurance, interest and retirement of the bonds. After the entire indebtedness incurred in construction is paid the bridge becomes the property of the county, and the county also has the right to purchase it at any time for the amount of outstanding indebtedness.

There can be no reasonable objection to the plan of toll refunding. Indeed it appears in some cases, at least, to be the only feasible method of obtaining needed bridges. It is preferable, I think, for the public to collect the tolls and avoid all question of private gain, but the Bear Mountain and Mobile methods will perhaps provide a solution when no other is possible.

THOMAS H. MACDONALD,
Chief, Bureau of Public Roads.

Washington, D. C.,
Dec. 11, 1926.

Sir—I have read with considerable interest the *Engineering News-Record* editorial of Dec. 2 entitled "Toll Bridge Reform" and believe that it expresses a popular misconception of the results of private toll bridge operation. The idea that the use of our national highway system is becoming throttled by toll bridge restrictions is not based on fact.

If it were possible to construct a privately owned toll bridge over any river in the United States toll bridge privileges would indeed constitute a menace, but due to the control of the situation by state and municipal authorities it is practically impossible for a private corporation to obtain permission to construct a toll bridge without the sanction of the interested political bodies. This means that there is really very little opportunity for the construction of privately owned small toll bridges, that is, bridges costing less than $300,000, because the states generally wish to include the construction of such bridges in their road building program if sufficient funds are available. As the field of operation for the toll bridge is thus generally limited to the construction of large bridges the possible locations for new bridges are quite few. This may become apparent when it is realized that there are not over 50 large rivers in the United States, if a large river is assumed to be one with a stream flow at flood stage of over 100,000 sec.-ft. Of these 50 rivers there are perhaps not over 15 which are in urgent need of new bridges, and of these fifteen there are perhaps not over five affording opportunities for profitable investment in toll bridges. There are, however, a few lakes, bays and inlets from the sea which might be added to this class. There is not only no possibility of returning to the old rightfully abandoned system of toll collection at frequent intervals along the public highways, but by the operation of present laws the existing toll bridges will eventually become free bridges. It might also be pointed out that toll bridges affording the best opportunities for profit are those whose traffic is largely to and from pleasure resorts or places which are not necessary to be reached for business reasons. For this traffic the payment of tolls seems equitable as such payments are not materially different from admission payments to private pleasure resorts.

Much has been said regarding the objections to the toll bridge, but should we not give some consideration to the service which it renders? The construction of a large toll bridge is certainly a hazardous undertaking from a financial standpoint because it is impossible even with those having considerable experience in the business to predict the vehicular traffic which will be obtained after the bridge is constructed. It is true that a few of the recently constructed toll bridges have proven to be quite profitable, even as much so as a successful industrial enterprise. But certainly the opportunity for a speculative profit should be permitted for assuming the risks involved. If during the past few years there had been no inducements for the construction of large toll bridges by private interest, it is quite certain that the bridges which were constructed would not have been built at all and the automobilists would still be suffering the almost intolerable inconveniences of crossing the streams by ferry.

Of course, it might be claimed that a state should build and operate a bridge which would not be a paying investment for a private corporation, but this would require the subsidizing of the bridge, whether it be toll or free, and the subsidy would be paid largely by those who would not use the bridge. If the traffic over a bridge will not pay a toll sufficiently high to make the bridge a profitable investment, it is reasonable to assume that the bridge is not an economic necessity and probably should not be built. In order to determine its economic necessity is it not good business to give those who are willing to risk their own money in proving the justification of the project the opportunity to do so?

I feel quite sure that this whole subject has received careful consideration at the hands of congressional committees and that the possibilities of abuse of privileges granted were well understood. The standard forms for bridge bills recently drawn up by the congressional bridge committee are intended to protect the interests of the communities served without destroying the incentive to individual initiative necessary for carrying out such undertakings.

New York City, J. K OSTRANDER.
Dec. 10, 1926.

Protections Against River Bank Erosion

Sir—Referring to the article entitled "Brush, Wire Mesh and Old Rails Make River Retards," published Oct. 7, 1926, p. 576, the writer has used similar methods of bank protection in the West Indies, and under almost identical conditions. The scour experienced, however, is so heavy that channel mattresses have to be provided to prevent the rivers cutting under the retards or dikes. The river beds are composed of gravel but the underlying material is hard clay and test borings for bridge foundations have shown that this exists at least for a depth of 100 feet. The gravel is on an average 12 ft. thick and several bridges have failed in the past after heavy scour took place. Instead of using deeper foundations as a remedy, good results have been obtained recently by building concrete aprons in front of the piers, Fig. 1. They extend from abutment to abutment and are backed with riprap on the downstream side.

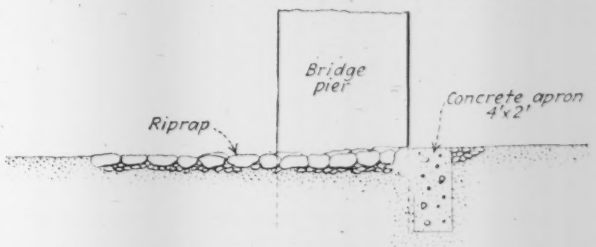


FIG. 1—CONCRETE ABUTMENT AND RIPRAP BACKING PROTECT BRIDGE PIERS FROM SCOUR

At places where bank erosion takes place rails 18 ft. long are driven with a penetration of 12 ft. and covered with close-mesh poultry wire, firmly secured to bands of No. 12 wire at the top, center, and bottom of the rails Fig. 2, each band consisting of 6 strands twisted together. The channel and shore mattresses are continuous and consist of two layers of poultry netting with stone between, the two layers of netting being tied together with short pieces of wire. The mattresses extend 12 ft. on the upstream side and 18 ft. on the downstream side of the rails.

The velocity of the river is effectively reduced by these dikes, large quantities of brushwood and trees are trapped and sand shoals are formed on both sides. Heavy scour takes place at the outer end and this must be provided for by carrying the mattresses well beyond the last rail.

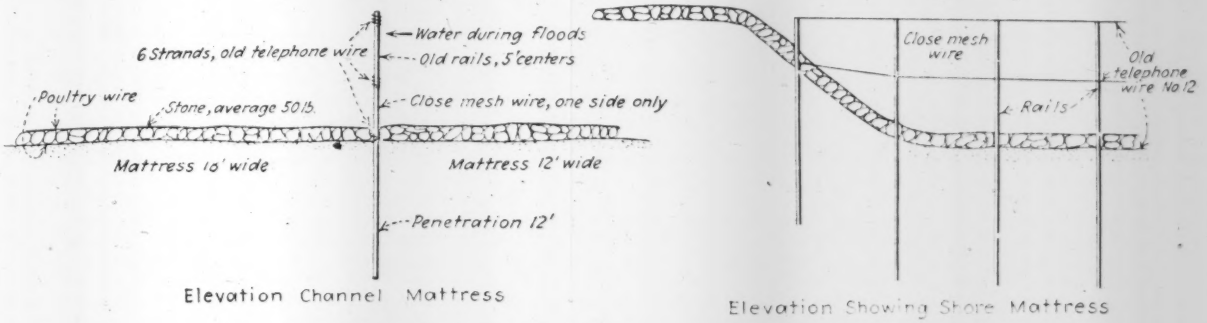


FIG. 2—DETAILS OF DIKES OF OLD RAILS AND WOVEN FENCE WIRES

Hog wire and stone mattresses 40 ft. wide and 12 in. thick are being constructed also, where it is advisable to allow the river to continue to erode its banks for a certain distance. They are wired to rails on the railway side and are intended to fall when the bank erodes, Fig. 3. The writer proposes two methods of wiring a mattress of this nature in order to divide the stone into compartments and so check its position when the mattress falls, Fig. 3, a and b. The form shown in Fig. 3b is being used at present. The bottom layers of hog wire are covered with stone and the edges of each width of wire firmly secured to the edges of

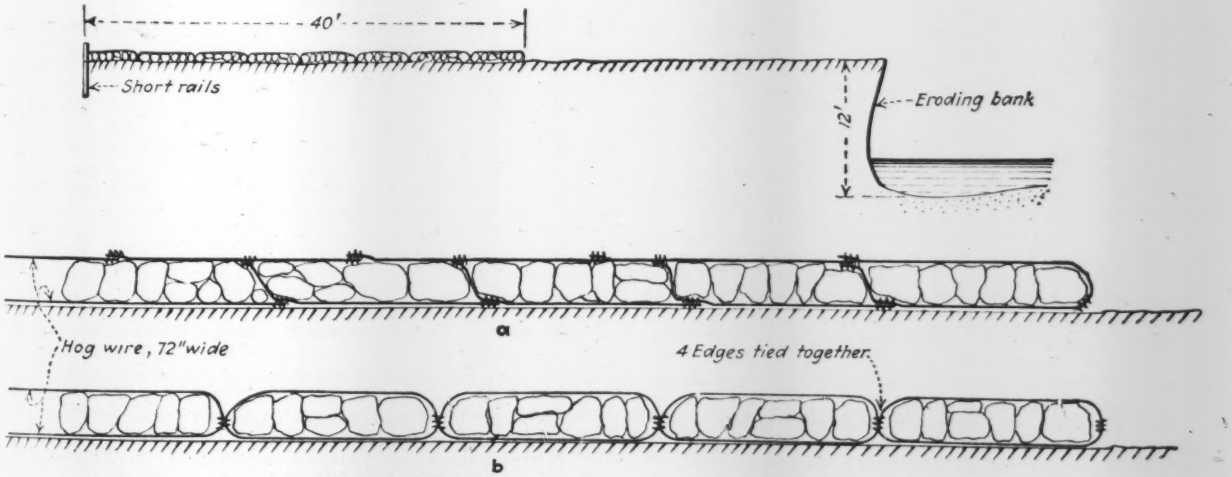


FIG. 3—METHOD OF STOPPING EROSION AT A PREDETERMINED POINT

the cover wire. In this way the mattress is divided into a series of "sausages," similar to those commonly used in dealing with channel scour.

A. W. ROGERS,
Resident Engineer, Samana and Santiago Ry. Co. Ltd.

Sanchez, Dominican Republic,
Nov. 20, 1926.

Inlet Screen and Aerator for Water Filters of Liverpool, England

Sir—I note in your issue of Sept. 30, p. 539, a description of the new filter beds of the Liverpool Corporation at Oswestry. I should like to clear up the doubt expressed in the last paragraph of your article as to the mode of operation of the inlet arrangements.

The methods adopted for distributing the raw water on the beds are the natural outcome of our experience with slow sand filters at Oswestry. The first beds at this place were constructed and brought into use about the year 1889, and the number has been gradually increased to the present total of 15 as the quantity of water drawn from Liverpool's main source at Lake Vyrnwy has been increased. In the original beds the water was admitted by a vertical standpipe brought up through the sand with a bell mouth discharging above top-water level. It is now recognized that any perforation of the filtering medium by inlet or other pipes is undesirable, and our later beds were arranged in such a way that the raw water was discharged at several points along the side above top-water level. The length of the openings through which the water was discharged was gradually extended as it was obviously desirable to expose the water as much as possible to air and sunlight.
sunlight.

In the three new beds an attempt has been made to carry this development as far as possible, and provision has been made for discharging water onto the bed by two entirely separate and independent means.

The spray jets, which are fully described and illustrated in your article, are intended to be used in ordinary working, when weather conditions permit. During high winds the water cannot be put on in this manner, as the loss from spray being blown away is considerable. The water is not strained at the filter beds before passing through the jets, as this cannot be conveniently done without sacrificing the pressure necessary to give the spray discharge, but it has previously been passed through copper gauze screens at the head of the aqueduct.

When weather conditions are unfavorable or for other reasons the jets are not available, water is admitted in a thin film running the whole length of the bed, by means of the distributing plate shown below the spray pipe on the diagram. This water is strained in the inlet channel. Two of the beds have inclined copper gauze screens, as illustrated, but in the third bed the screens have been omitted for the present and the straining is effected by passing the water upward through a thick bed of pea gravel.

It will be noticed that the spray inlet enables the bed to be kept in operation while the gauze screen or other straining medium is being cleaned.

The filtering medium in the new beds has not yet been thoroughly matured, and considerable time must be allowed before the new sand acquires the same ripeness as that which has been in use for several years in the older beds. As soon as this stage is reached, it is intended to carry out a series of experiments to compare the respective merits of the different methods of admitting water to the new beds. One bed will be supplied through the spray jets; the second will have the water flowing on over the distributing plate, after being strained by copper gauze screens; while the third bed will also be supplied by the distributing plate, but the straining will be effected by the gravel bed.

It is as yet too early to form any definite opinion as to the success or otherwise of the new designs, but the evidence at present available indicates that a reduction in the frequency of cleanings of the beds for a given quantity of water filtered has been realized.

After cleaning, the beds are flooded by introducing filtered water from underneath, and thus any disturbance of the sand by water falling on it from the inlet is avoided.

Liverpool, England,
Oct. 26, 1926.

J. R. DAVIDSON,
Water Engineer.

Hurricane Tide Heights at Miami

Sir—As a recent article in your paper reports water levels during the Miami hurricane of Sept. 18, 1926, somewhat at variance with the researches of the Harbor Division of the city of Miami, I wish to present our results in part so that your records may contain this information.

Biscayne Bay is a shallow body of water about 50 mi. long. The city of Miami Beach is on the southern end of a narrow peninsula lying between the ocean and the northern part of the bay. South of Miami Beach is a chain of islands or keys between bay and ocean, but beginning about 7 mi. south of Miami Beach is a large opening in this chain about 10 mi. long. Two causeways which are serious obstacles to the flow of water reach from the southern part of Miami Beach across the bay to Miami, which is opposite on the mainland.

After the storm this office measured the level of water lines left in the inside of buildings where wave action could not appreciably affect results. We took more than 35 such observations along the water front in Miami, on an island in the bay, and southward 8 or 9 mi., the southernmost observation being within a couple of miles of the large opening referred to above. These levels presumably gave the maximum height to which the water rose. They varied from 7.1 ft. at the foot of 18th St. N. E. to 11.7 ft. at the foot of 6th St. S. E., with a similar reading several miles south. The farthest south was 10.54 ft. All levels are referred to mean low water, U. S. Engineer Department datum.

In some ways the observations taken by E. R. Naff, city engineer of Miami Beach, are more interesting. He took fifty observations on water levels, also inside buildings, free from wave action, and plotted his results to include four profiles of the maximum water levels together with ground elevations, each profile running from near the sea across Miami Beach to near Biscayne Bay. These show that the land along the ocean front varied from 6.25 to 10, while along the bay it was everywhere near 4.5. There was a sheet of water flowing across the city at an average of 2 or 3 ft. deep with its surface sloping from about 10 ft. near the ocean to about 6½ or 7½ ft. near the bay. The four highest observations, all near the ocean, are 10.58, 10.58, 10.51 and 10.7, while the lowest observation was 6.13, near the bay.

A study of Mr. Naff's observations show that they are consistently in line with each other and with the general facts in the case, which only adds to their reliability. It seems to me that they show that the maximum height of the storm tide in the ocean at Miami Beach was near 10 to 12 ft. and not 6 ft., which is the height given on p. 946 of your issue of Dec. 9. Unfortunately the reasons for deleting the 6 ft. height are not given.

The maximum storm tide level in the sea has an important bearing on the question of protecting Miami against high water in future storms. Conclusions of this office are briefly as follows:

The ocean rose well above the level of Miami Beach and the islands to the south, and the water rushing into the bay over and between these bodies of land and particularly through the 10-mi. opening very materially raised the average height of the water in the bay. This was the real source of the trouble, the rushing of water from one end of the bay to the other causing less increase in water levels. The evidence of water heights south of the large 10-mi. opening is deficient, but undoubtedly the large amount that ran through the opening spread out to the north, helped out by a southern component of the wind in the second period of the storm. However, from near the opening up to the causeways we found little variation in water levels along the mainland, but north of the causeways the water was several feet lower, indicating that much of it came from the south. We have also evidence that the water was lower on the east side of the bay than at Miami. It would seem then that the proper protection was, first, to keep the water from coming in from the sea, and second, or less important, to build additional obstacles to the movement of the water in the bay.

F. W. ALSTAETTER,
Colonel, U. S. Army Retired,
Consulting Engineer to the City of Miami in Harbor Matters.

Miami, Fla.,
Dec. 16, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Boulder Canyon Bill Is Favorably Reported

Retains Power Development and All-American Canal—Repayment Contracts Vital Issue

On Dec. 22 the long pending Boulder Canyon bill was advanced in its course through Congress by a favorable report to the House from its committee on irrigation and reclamation. The bill reported is a complete revision of the bill as last introduced in the House (Feb. 27, 1926), but the changes are in detail and form of expression rather than in essentials. The method of handling the construction fund and repayment moneys is rewritten according to suggestions of the Treasury Department. The bill embodies formal approval of the Colorado River Compact, and a number of its clauses are devoted to reiteration of the fact that the whole project and the water rights accruing under it are contingent upon the compact.

In reporting the bill the committee discusses each of the main objectives of the Boulder Canyon storage project and concludes with a summary giving as reasons for the passage of the bill (1) to eliminate the risk of a flood catastrophe to Imperial Valley; (2) to assure the development of irrigation in the lower basin of the Colorado River before the river is pre-empted by power development and by Mexican irrigation; (3) to provide a domestic water supply to southern California; and (4) to settle in large part water rights between states. The report says that "the provision to settle water rights on the river have come largely from the official representatives of upper basin states."

Summary of Revised Bill

Section 1 of the revised bill authorizes the Secretary of the Interior to construct, operate and maintain (a) a dam and incidental works in the Colorado River at Black Canyon or Boulder Canyon for a storage of not less than 20,000,000 acre-feet, (b) a canal entirely within the United States connecting Laguna dam with the Imperial and Coachella valleys, and (c) an electric power plant at the dam, this plant to be located "within a state which has approved the Colorado River Compact." To be entitled to irrigation benefits from the storage, owners of irrigable lands over 160 acres must agree to sale of the excess lands at prices fixed by the Secretary of the Interior on the basis of appraisal without reference to the construction of the project.

Section 2 establishes a Colorado River dam fund, to which the Treasury may advance a total of $125,000,000 if and as appropriated by Congress and as called for by the Secretary of the Interior, which fund shall pay interest at the rate of 4 per cent. Into this fund all revenues shall be paid, and from it all expenditures for construction and for interest during construction are to be made.

Section 3 authorizes the appropriation from time to time of $125,000,000 (but makes no appropriation).

Section 4 requires approval of the Colorado River Compact without condition by the six basin states (excluding Arizona). It also requires that before money is appropriated or construction work done or contracted for, repayment contracts shall be made to insure not only payment of all expenses of operation and maintenance but also repayment within 50 years of the construction cost, with interest.

Section 5 authorizes the Secretary of the Interior to contract for storage and delivery of water and delivery of electrical energy at the switchboard, for adequate charges. Irrigation and domestic use contracts shall be for permanent service. Power contracts shall be for 50 years or less, subject to future renewal, and shall be made in conformity with the policy laid down in the Federal Water Power Act as to conflicting applications. Licensees of 100,000 hp. or more may be required to open their transmission lines to joint service of licensees of less than 25,000 hp. Public lands are made available to transmission-line construction.

Section 6 specifies that operation of the Boulder Canyon reservoir shall

(*Continued on p. 1093*)

Engineering Fifty Years Ago

From *Engineering News* of December 23, 1876

THE commissioners appointed to condemn the land for the Hudson River Tunnel, met on the 16th inst. Propositions were submitted to the Tunnel Co., the salient features of which were that the Tunnel Co. must be responsible for all damages occasioned to the property of other companies; that it shall restore, if it abandons the work, everything to its primitive condition; that the tunnel must be constructed in such a substantial manner as to admit of the erection of buildings over it by the other companies if desired; and that if the price of them; and could not be agreed upon by the parties interested, the question should be decided by the commissioners. These conditions were immediately accepted by the Tunnel Co. Work on the tunnel will probably commence Jan. 1st.

Responsibility Unfixed in Claremont Tunnel Deaths

Break in Sand-Bag Dikes Ascribed to Abnormally Wet Month, Culminating in Downpour

The flood that drowned ten men on Thanksgiving Day in Claremont Tunnel on the outskirts of Oakland, Calif., was the result of rainfall exceeding twice the average in that territory for the month of November. Because of the holiday, officials ordinarily at the tunnel who would probably have foreseen the danger in the emergency, were away. The coroner's jury brought in a verdict of "Death from accidental drowning" and reported that it was "unable to fix responsibility for the accident." The tunnel is being built under contract for the East Bay Municipal Utility District. A news report of the accident appeared in *Engineering News-Record*, Dec. 2, p. 925.

San Pablo Creek has a drainage basin of about 10 sq. miles above the point where it crosses the Lafayette tunnel now under construction for the East Bay Utility District. This crossing is near the junction of the Lafayette and Claremont tunnels where a concrete wasteway structure has been built to discharge any spillage from the tunnels into San Pablo reservoir, about 1½ miles below. This spillway structure is built in an excavation carried well below the level of San Pablo Creek, whose original bed at this point was 3 ft. above the concreted top of the tunnel.

Sand-Bag Dikes Used

At the time of the flood the creek was being carried over a portion of the tunnel built by the cut-and-cover process, in which concreting had been finished, the stream flow being retained between two sand-bag dikes, as shown in the drawing. The safe capacity of the channel between these dikes was estimated by Utility District engineers at between 900 and 1,000 sec.-ft. In normal years this would have been ample but the total rainfall in November this year was 7.98 as against an average for November of 3.8 and it culminated in an extremely heavy downpour on the afternoon of Thanksgiving Day. The creek level rose, under the runoff from this heavy precipitation, until the east cofferdam gave way and the flood waters poured over it, entering the concreted tunnel below. Thus, water passing west through the completed portion of the tunnel filled the excavation around the wasteway and it was from this source that the Claremont tunnel was flooded.

This end of the Claremont tunnel has been driven from the shaft, shown in the drawing. Timbering was completed practically as fast as the headings were advanced. West of the shaft the heading had been advanced 1,400 ft.

while to the east driving was done 628 ft. from the shaft or 20 ft. from the face of the wasteway excavation, as shown in the drawing.

This 20-ft. plug was left as a safeguard against any danger or interference between operations of two contractors. The Smith Bros.' contract covers work from the east up to and including the wasteway structure, and at this point begins the work to the west under contract to Grier & Mead. Between Nov. 9 and Nov. 11 the latter contractor put a 4-ft. drift through this 20-ft. plug in order to provide a convenient outlet for a 4-in. discharge pipe from a drainage pump. The pump was near a sump at this face of the tunnel and a discharge pipe into the wasteway called for much less lift that would have been required to pump up the shaft. The 4-ft. drift passed through earth and gravel on a layer of rock and was timbered throughout.

When the wasteway excavation was filled above the level of this adit with flood waters of course Claremont tunnel filled rapidly; so rapidly, in fact, that only the eleventh man of the crew who happened to be near the bottom of the shaft had time to climb to safety.

In the emergency work of pumping out the tunnel to recover the bodies an earth fill was placed over and around the adit where the water entered.

Land Owner's Right to Flood Waters Upheld in California

The Supreme Court of California has handed down a decision in the now famous Herminghaus case upholding the Superior Court and ruling that the Southern California Edison Co. has no right to store flood waters of the San Joaquin River. This decision holds that the plaintiffs are entitled to flood waters that naturally overflow their lands and places this right superior to that of the power company.

The decision holds unconstitutional and beyond the power of the legislature that provision of the Water Commission Act which limits the land owner to such quantity of water as is reasonably necessary for the irrigation of his land. Because the decision makes possible "hold-up values for swamp and overflow land" it is regarded as of great importance to power companies throughout the West.

Further details of the case will be discussed later.

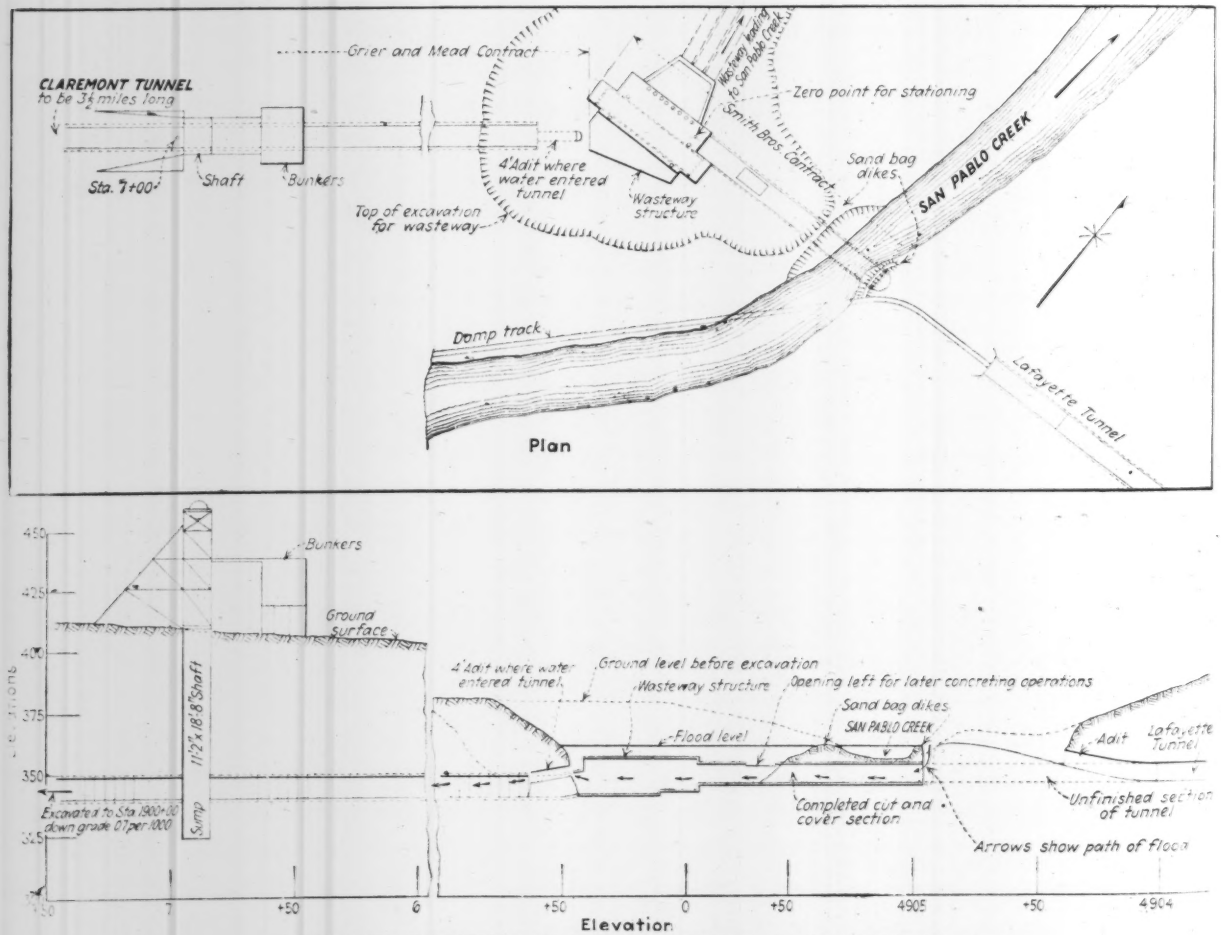
Honduras to Build Macadam Road 30 Miles in Length

The government of Honduras has entered into a contract with interests in New York City to build a macadam roadway from Tegucigalpa northeast to Juticalpa, a distance of more than 30 miles, according to the Department of Commerce. For this purpose, the Honduras Government has issued $500,000 in bonds which have been taken privately at 92.

It is understood that according to an agreement, the Honduras Government will levy a road tax for the retirement of the bonds. The work is to be carried on on a monthly basis, and the engineer in charge of the construction is to report monthly whether or not road work to the value of $46,000 has been completed. If such has been the case, the New York interests will advance the following monthly installments.

If the construction of this roadway is successful, it is planned to have a road issue of $2,000,000 under which issue the work will require 20 months at $100,000 monthly. The roads contemplated under the issue are to cover the routes from San Pedro Sula, on the Honduras national railway, southwest in the direction of Santa Barbara, with a branch to Santa Rosa de Copan in the Department of Copan. That roadway, together with one from Tegucigalpa to Yuscaran, is estimated to absorb one half of the bond issue.

The other roadway, from Potrerillos to Comayagua, will consume the remainder of the sum voted.



PLAN AND ELEVATION OF TUNNELS WHERE FLOOD ENTERED

Financial Condition of Canadian National Railways Improved

The steady improvement in the position of the Canadian National Rys. is shown by the annual report of the Canadian Department of Railways and Canals. While in 1920 operating results showed a deficit of $34,532,000 and in 1921 a deficit of $11,543,000, operations during succeeding years have shown surpluses increasing from $2,886,000 in 1922 to $32,264,000 in 1925. The total deficit which has been met from year to year by advances from the government or loans from private individuals amounts to $356,308,000. The report states that the pronounced improvement of 1925 carries with it the expectation that the management of the Canadian National Rys. will be in a position to pay all the interest charges due the public from its own earnings, which would mean for the first time it has been possible to meet such charges without borrowing.

Boulder Canyon Bill Reported

(*Continued from p.* 1091)

serve first river regulation and flood control; second, irrigation and domestic use and satisfaction of present rights; and, third, power. It establishes perpetuity title to dam, reservoir, plant and incidental works in the United States, and declares that the United States shall always control and operate them. However, the Secretary of the Interior may lease part of the power plant or may lease a certain discharge of water for the generation of electrical energy "within a state which has approved the Colorado River Compact." Maintenance of works, control of rates and service (in the absence of state regulation or interstate agreement), rate-making valuation, transfers of contract, expropriation of excessive profits and the like are placed within control of the Secretary of the Interior.

Section 7 provides that the All-American canal may be transferred to the users when paid for, and also gives the users the right to develop and benefit by any power along the canal.

Section 8 makes the Colorado River Compact controlling upon appropriators, permit holders or licensees, and the United States, and also makes these subject to any agreement between Arizona, California and Nevada for division of the water use and power if approved by the states and Congress before March 4 next (or, under certain limitations, later than March 4).

Section 9 provides for withdrawing from public entry irrigable public lands, and provides for subsequent entry, with preference to ex-service men. Sections 10 and 11 deal with the existing Imperial Irrigation District contract to buy a share in Laguna Dam, and with definitions. Section 12 contains a formal approval by Congress of the Colorado River Compact as a six-state agreement. Section 13 makes the bill a supplement to the reclamation law.

Section 14 directs the Secretary to investigate and report the feasibility of irrigation, power an other projects in Arizona, Colorado, New Mexico, Utah and Wyoming, with a view to formulating a comprehensive scheme of headwater control and the improvement and utilization of the waters of the river. For this investigation it appropriates $250,000.

Governor Hunt has called a special session of the Arizona Legislature for Jan. 3, one week in advance of the regular session. According to press reports this is because of the administration's belief that "the general situation as it affects Arizona has been endangered and aggravated by the approval granted the Swing-Johnson Bill by the Senate Committee on Irrigation and Reclamation."

Robert Trimble, Assistant Chief Engineer of P. R. R., Retires

Robert Trimble, assistant chief engineer of the Pennsylvania Railroad Co., will retire from active service on Dec. 31, 1926, after reaching the age of 70 years and having completed 51 years of service with the Pennsylvania R.R.

Mr. Trimble is a native of Butler, Pa., and received his technical education at the Western University of Pennsylvania, now the University of Pittsburgh. He entered the service of the Pennsylvania R.R. in 1875, beginning as a chainman in the office of the chief engineer at Pittsburgh and working up through various positions of chainman, rodman and levelman until 1880 when he was appointed resident engineer in charge of construction of the old Chicago Union Station. Upon the completion of that work in 1881, he returned to the Pittsburgh office as assistant engineer. It is interesting to note here that when it became necessary to replace the old Chicago Union Station, Mr. Trimble was chosen chairman of the Advisory Board of Engineers to supervise the erection of the new structure.

In 1889 Mr. Trimble was made principal assistant engineer of what was then known as the Northwest System of the Pennsylvania lines west of Pittsburgh, and on Jan. 1, 1903, he was appointed chief engineer, maintenance-of-way, of the same lines, with entire charge of construction work and as consultant on maintenance work. In July, 1918, he was relieved of charge over maintenance matters and appointed chief engineer-construction for all new work on the Pennsylvania lines west of Pittsburgh.

Mr. Trimble became assistant chief engineer of the Pennsylvania R.R. System on March 1, 1920.

During his half century of service with the Pennsylvania R.R. Mr. Trimble has devoted most of his time to the engineering department of lines west of Pittsburgh.

Mr. Trimble is a charter member of the American Railway Engineering Association and served that organization as president during the year 1915.

New Bridge Over St. Lawrence River Proposed

The efforts of a great number of Canadians to devise some method whereby the sixtieth anniversary of confederation may be permanently commemorated have resulted in several suggestions. One of these is a proposal to erect an international bridge across the St. Lawrence, connecting New York State with the province of Ontario. The site for the bridge is tentatively located near Brockville. The new structure would form the main link in a Capital-to-Capital route from Washington to Ottawa.

A big delegation recently waited on the Ontario Government officials in an effort to secure the assurance that the provincial Government would co-operate with the Dominion Government in assisting the project. According to one of those interested in the matter, it is planned to utilize an old charter which was issued to the New York Central Railway to construct the bridge. It is stated that the Ontario Government is likely to view the project with favor as it would facilitate tourist traffic and connect with the Toronto-Ottawa highway system.

Recent reports from Ottawa to the effect that private interests were ready to start construction of such a bridge within thirty days cannot be credited as the International Joint Commission has not received an application for any bridge near Brockville. Approval of the commission is necessary before any bridge can be built.

Hurd Resigns from Indianapolis Sanitary Commission

Charles H. Hurd has resigned as consulting engineer to the Indianapolis Board of Sanitary Commissioners, the chief work of which was the construction of the activated sludge plant designed by Mr. Hurd and built under his direction. The resignation is attributed to ill health on the part of Mr. Hurd and to the dissensions within the Commission, noted in *Engineering News-Record*, Aug. 26 and Sept. 16, 1926, pp. 356 and 380.

St. Louis Engineers Entertain Legislators at Dinner

Following a custom established last year, the engineers of St. Louis, Mo., on Dec. 14, entertained at dinner the senators and representatives-elect from St. Louis and St. Louis County. The dinner was given under the auspices of the St. Louis Institute of Consulting Engineers at the University Club. The primary idea was to acquaint the legislators with the engineers' position on various matters of public interest. The toastmaster was Philip N. Moore and the speakers and their subjects: A. P. Greensfelder, "Parks for Missouri"; Charles M. Talbert, "The State and Public Safety"; Edward E. Wall, "Water Supplies"; Arthur Tacher, "State Geological Survey"; William C. E. Becker, "Some Limitations"; Erle Ormsby, "Smoke", and Charles E. Smith, "Transportation — City and State."

Conference Held on Abolition of Cross-Connections

On call of the State Department of Health of Connecticut about fifty water-works officials met at Hartford on Dec. 14. The main topic discussed was the carrying out of the recent order of the department calling for the abolition of all cross-connections between municipal and industrial water supplies by Dec. 31, 1926, except for temporary extensions of time where double check valves of approved type are installed. Warren J. Scott, director of the department's Bureau of Sanitary Engineering related some of the experiences resulting from the order. There were also round-table discussions on rating water supply for fire protection, on watershed policies and a description of the new filter plant at Wallingford.

Detroit Engineers Hear Lectures on Strength of Materials

At the suggestion of Dean Cooley, University of Michigan, and in co-operation with the Detroit Engineering Society, a course of fifteen evening lectures on "Strength and Resistance of Materials" is being given at the society's rooms by Professor Henderson, director of the University extension division. More than fifty engineers paid for this course at the start.

Health Board Acts on Los Angeles County Ocean Outfall Sewer

The California State Board of Health has for some time had before it for adjudication several locations for the large south outfall sewer of the Los Angeles County Sanitation Districts, all pivotal about San Pedro and all in deep water in the Pacific Ocean. The proposed sewer is estimated to be capable of serving 1,800,000 people and would have a capacity of 350 sec.-ft. of fine screened sewage.

There was so much difference of opinion as to relative danger of beach pollution in the different locations that the Los Angeles Chamber of Commerce late in November appointed a committee of three engineers to recommend the best location. This committee reported in favor of a location not previously considered which followed the San Pedro breakwater part way.

After an investigation on its own account the State Board of Health held hearings on the subject with the result that under date of Dec. 18 a denial of pending applications was issued with recommendation that petitioner renew application for either of two new locations which the board suggested as preferable to those for which permits had been asked.

The alternate locations for which permit was asked ranged from 2,260 ft. to 11,000 ft. from shore off White's Point or Point Firmin. The two locations preferred by the board, both for discharge after fine screening are (1) 17,500 ft. south of the shore of Terminal Island at the foot of Badger St. extended and 4,000 ft. east of the San Pedro breakwater or (2) a point 4,000 ft. south from the breakwater at least 9,000 ft. from Cabrillo Beach where Los Angeles proposes to build an ocean-front park.

The report to the board by C. G. Gillespie, director and chief sanitary engineer, states that under conditions in the vicinity concerned and "so far as the art of sewage treatment now stands, it is cheaper in the long run to sewer to the ocean."

WASHINGTON NOTES

WITH the impracticability of the Lakes-to-Hudson waterway regarded as established by the report of the special board of engineers, and with the feasibility of the St. Lawrence development further emphasized by another engineering report, efforts in administration quarters now are being concentrated on the problems which must be solved in the negotiations with Canada.

The report on the Lakes-to-Hudson route is so unfavorable that it is expected to deflect many of those who have supported the plan and to reduce the effectiveness of any further advocacy of that project.

Now that the engineers have developed that the closed season would not be appreciably longer on the St. Lawrence and that the route across New York State would have no particular military advantage, more domestic support for the St. Lawrence is confidently expected. In addition, the wide difference in the costs of the two projects and the need for the power attract further strength to the St. Lawrence improvement.

FOLLOWING an agreement on the Illinois River item the Senate had little trouble in bringing to a vote and accepting the other two controverted provisions of the bill—the purchase of the Cape Cod Canal and the authorization for the improvement of the upper Missouri River.

After days of debate the Senate finally authorized a 9-ft. project through the Illinois River but with the proviso "that nothing in this Act shall be construed as authorizing any diversion of water from Lake Michigan."

As this is written it seems probable that the House will concur in the Senate amendments, thereby obviating the need for a conference and removing the possibility of a further filibuster on the conference report. An appropriation of $3,500,000 is authorized for the Illinois River project. This action practically assures the 9-ft. Lakes-to-Gulf waterway.

The appropriation which will be authorized for the Missouri if the bill becomes a law is $12,000,000. This is to be applied on a 6-ft. channel from Kansas City, Mo., to Sioux City, Iowa.

In addition to the authorization for the purchase of the Cape Cod Canal the bill adopts the New Orleans-Morgan City sector of the Intracoastal Canal; the sector Beaufort to the Cape Fear River in North Carolina and the sector between Jacksonville to Miami, in Florida.

Ontario Hydro Commission Sued Over Intake Patent

An action for infringement of a patent has been brought against the Hydro-Electric Power Commission of Ontario by Benjamin F. Groat, hydraulic engineer, Philadelphia, Pa. Mr. Groat hols patents in both the United States and Canada for a method of diverting ice from intakes by "transportivity control," and claims that his method has been used in the construction of the intake for the Queenston-Chippawa power plant with immaterial variations without acknowledgment of his patent rights.

Stone & Webster Organizes Security Company

Stone & Webster, Inc., and Blodget & Co., have formed a new company under the name of Stone & Webster and Blodget, Inc., which will be in operation Jan. 1, 1927, with a net authorized capital of $10,000,000.

The corporation is a combination of the securities department of Stone & Webster, Inc., and the old investment house of Blodget & Co. The head offices of the new company will be at 120 Broadway, New York City. Each company has been maintaining offices in New York, Boston and Chicago. These will be consolidated in this city under the new plan.

Stone & Webster and Blodget, Inc., will offer a complete service both to investors and to issuers of securities, namely, municipalities, railroads, public utilities and industrial companies. It will give investors increased efficiency in handling their accounts, additional facilities as a result of investigation of new issues and diversification of securities lists.

Assessment Plan Proposed for Chicago Rapid-Transit

A new phase of Chicago's tangled rapid-transit problem is a definite recommendation for part payment of the cost of subways and elevated extensions by special assessment of property benefited, and the approval of this method by city council. The assessment plan was recommended in a report by an advisory commission composed of representatives of owners of large stores, hotels, office buildings and theaters in the business district, upon whom would come a large share of the assessment. Whether this method of providing funds is practicable for such a purpose is a legal question which remains to be decided. The commission was appointed by a sub-committee of the council committee on local transportation, and had R. F. Kelker, Jr., as its engineering council.

To supplement its conclusions, the commission recommended that the Board of Local Improvements should institute "local improvement" proceedings for the proposed Ashland Ave. extension and Wells and Polk Sts. extension of the elevated lines; also that such part of the cost of these improvements as is not provided by assessments should be paid from the city's traction fund. Another important recommendation was that an ordinance

should be prepared for the consolidation of all surface and rapid-transit lines in order to secure unified service. But the recent receivership of some of the surface lines has put another obstacle in the way of such consolidation.

In addition, the report recommended that steps be taken for the construction of two subways, with an assessment on property benefited to cover not less than 55 per cent of the cost, and the council has ordered the preparation of the necessary ordinances. The assessment percentage would vary in certain zones. One subway, for rapid-transit service, would extend under State St., from 13th St. to North Ave., connecting with the elevated lines at each end and having four tracks through the shopping district. The other subway, for west-side street cars, would form a loop connecting the present Washington St. and Van Buren St. tunnels under the river; it would run east under Washington St., south on Michigan Ave. and west on Jackson St., then diverging south to the Van Buren St. tunnel. This loop would pass under the rapid transit subway.

Personal Notes

W. B. POLAND, director-general of government railways and port construction, located at Belgrade, Serbia, has been appointed director-general of railway surveys for the Persian government, with headquarters at Teheran, Persia.

BYRON FILE of Charleston, Mo., on Dec. 13 was appointed by Governor Sam A. Baker highway engineer for Mississippi County to succeed P. A. TANNER of Charleston, Mo., who resigned.

GORDON R. WEST, of New York City, a reclamation engineer, has been employed by the Missouri Pacific R.R., to handle reclamation and development projects in the territory served by the Missouri Pacific system. He will serve purely in an advisory capacity, cooperating with engineers and officials on all projects involving the development of unused lands in the railroad's territory. For the past ten years Mr. West has been associated with and in charge of important reclamation and irrigation projects in Equador, Colombia, Venezuela, Peru, Lower California and Mexico.

J. E. SIRRINE & Co., engineers, of Greenville, S. C., will open a branch office in Birmingham, Ala., on Jan. 1, 1927. This is the second branch office this company has established, the first being opened in Chattanooga two years ago. G. P. PATTERSON, who has been with the company for seven years, will be in charge of the Birmingham office.

DAN W. PATTON, for the past nine years engineer of highways at Tulsa, Okla., has severed his former connections, after having planned and constructed nearly 200 miles of pavement in Tulsa County and serving as consulting engineer on other projects. He was formerly national director of the 6th District, American Association of Engineers. Mr. Patton was twice president of the Oklahoma Society of Engineers. No announcement is given of his future business connections.

E. T. THURSTON, consulting engineer, San Francisco, Calif., has been elected president of the Commonwealth Club of California. This club has a membership of about 2,500 and devotes attention particularly to civic affairs and matters affecting the interests of San Francisco generally.

J. M. FARRIN, assistant engineer, Illinois Central R.R., has been appointed special engineer, with office at Chicago.

LIEUT. COL. MAX C. TYLER, who for the past three years has been district engineer of the Florence district, Florence, Ala., has been ordered to the Philippine Islands for duty. Capt. Hugh P. Oram is acting district engineer at Florence.

R. S. RANKIN, for some time with Pearse, Greeley & Hanson, consulting engineers of Chicago, will become associated with the sanitary engineering division of the Dorr Co. on Jan. 1. He will make his headquarters at the New York office of this company.

F. M. HAWTHORNE, division engineer of the Pennsylvania R.R., at Terre Haute, Ind., has been appointed acting superintendent at that place.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention and Road Show, Chicago, Ill., Jan. 10-14, 1927.

AMERICAN ENGINEERING COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-15, 1927.

SOCIETY OF AMERICAN MILITARY ENGINEERS, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 17, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 19-21, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, Asheville, N. C., Jan. 24-28, 1927.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1927.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Chicago, Ill., May 9-12, 1927.

The Los Angeles, Calif., Engineers Club, formed in November, announces that its work is now under full headway, with membership applications approaching the 500 mark. Headquarters is in the Hayward Hotel. The officers are: President, Frank H. Olmstead; vice-presidents, J. E. Dodge and H. L. Doolittle; secretary and treasurer, R. F. Wate.

The International Association of Street Sanitation Officials announces its annual conference for Jan. 10 and 11, 1927, at Hotel Statler, St. Louis, Mo.

The Engineering Society of Buffalo, N. Y., the Buffalo Section of the American Society of Civil Engineers, and the Peninsular Section of the Engineering Institute of Canada sent delegations for a ceremony Dec. 6 and inspection of the new International Peace bridge over Niagara River between Buffalo, N. Y., and Fort Erie, Ont., which is rapidly nearing completion; the Canadians and Americans, guests of Edward P. Lupfer, of the Fort Erie Bridge Co., were the first group to cross the bridge, and William Huber, American, shook hands with E. S. Miles, Canadian, at the international line.

Obituary

A. M. STEIN, in Denver, Colo., contractor and a charter member of the Master Builders Association, died Dec. 19, aged 82 years.

HENRY C. ALLEN, 78 years old, city engineer for Clinton, Mo., died suddenly on Dec. 20. For twenty years he served as surveyor for Henry County, Missouri.

ALEXANDER DUTHIE, 60, Denver contractor, died Dec. 13. He was a native of Scotland, going to Denver 40 years ago.

EDWARD T. P. SHEWEN, of St. Johns, N. B., special engineer in the department of public works of New Brunswick, died in St. Johns Dec. 9 at the age of 77 years. Mr. Shewen was born in England. Before going to Canada he was an officer in the British army. In Canada he was first connected with the Intercolonial Ry. and reported on the ferry to Prince Edward Island. In 1895 he became resident engineer, at St. Johns, for the Public Works Department of Canada and from that date to his retirement in 1911 supervised the construction of many harbor works, including the West St. John docks. Subsequent to 1911 he served as consultant engineer on many engineering undertakings throughout Canada.

HARVEY J. DRESSLER, of the firm of Cellarius and Dressler, civil and consulting engineers, Dayton, Ohio, died suddenly during an operation on Dec. 9, 1926. Mr. Dressler graduated in civil engineering from Ohio State University in 1909 and since that time had been located at Dayton, part of the time in the service of the city as assistant, city engineer. During the war Mr. Dressler served overseas and was with the Army of Occupation until 1919.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Road Show Exhibitors Now Total 299

As has been the case for the past several years, exhibitors at the Road Show in Chicago, held in connection with the convention of the American Road Builders Association Jan. 10-14, are limited to the space available. As usual the number of applications has exceeded the supply of space although several buildings adjacent to the Coliseum have been secured to give more manufacturers an opportunity to be present. The value of the equipment to be exhibited by the manufacturers, 299 of which had been granted space up to Dec. 23, is placed at over $3,000,000.

Truck Crane Companies Form a National Association

In many communities throughout the United States within the past few years there have been formed organizations owning and operating truck cranes and offering a crane service on an hourly, tonnage or contract basis for those companies that have insufficient crane work to afford owning such equipment. At a meeting in Cleveland recently a national association named the Crane Service Association, was formed by unanimous vote of the delegates sent by companies who offer such crane service in their local communities.

The meeting grew out of the idea and wish of Frank A. Peck, vice-president, Universal Crane Co. A temporary committee was formed which made arrangements for the meeting at which about forty representatives of crane service companies were present. The program consisted of talks on the following subjects: Crane Service Company Advertising, by E. R. Van Bergen, Artcraft Printing Co., Cleveland; Methods of Taking Various Jobs, by W. O. Dinsmore, Motor Haulage Co., Minneapolis; Rental to Contractors, by W. H. Smith, Universal Crane Service Co., Springfield, Mass.; Rental by Contractors, by R. E. Laubscher, vice-president, Sam W. Emercon Co., Cleveland; Accounting Systems, by Joe Downing, Downing Crane Service Co., Buffalo; Building Excavating, by K. H. Shriver, Shriver Contracting Co., Pittsburgh; Hook Block, Steel Erecting, etc., by E. J. Proctor, Flint Builders Supply Co., Flint, Mich.; Material Handling by Samuel Simon, the Baer's Co., Chicago; Trench Work, by Peter Herkner, Herkner Motor Trucking Co., Cleveland; Winter Work, by Ed Amish, George Amish & Son, Rochester; Municipal Work, by Leo Coffman, Coffman Crane Service, Detroit; Co-operation of Owners, by Clayton Farris, Crane Service Co., Newark, N. J.

Officers elected were: Peter Herkner, Cleveland, president; Charles O'Brien, Cleveland, vice-president; Q. J. Winsor, Cleveland, secretary and treasurer. The Executive Committee consists of R. Summers, Birmingham, Ala.; C. Farris, Newark, N. J.; L. Coffman, Detroit, Mich.; S. Simon, Chicago, Ill.; and W. H. Smith, Springfield, Mass.

Other companies offering the same service are invited to join the association whose offices are located at 914 Swetland Building, Cleveland.

Chlorinating Patent Decisions

A news item was published in these pages in the Dec. 9 issue citing the grant of a preliminary injunction against Garden City, L. I., in respect to the use of the chlorinating apparatus in its water supply plant furnished by the Paradon Engineering Co. This company now points out that the decision was not against the Bull patent as such but more correctly against the manner in which the city was using the apparatus. The Bull process provides for the use of comminuted iron (small pieces of iron) in the pot attached to the chlorinating apparatus. The judge's decision says that "the evidence shows it was filled with tenpenny nails. Such nails are not what was described by Bull as comminuted iron." The Paradon company, which is licensed under the Bull patents, further calls attention to other decisions handed down in the same court in which the Garden City case was tried. On Oct. 30, 1926, motions were denied to hold the Paradon company in contempt of court for shipping several of its solution feed chlorinators using the Bull process to Seattle, Wash., and to Champaign, Ill.; the plaintiff had alleged that the equipment practiced the Ornstein process. A motion was also denied to extend a previous injunction covering the Ornstein process so as to include chlorinating units practicing the Bull process.

Business Notes

ARMCO CULVERT & FLUME MANUFACTURERS ASSOCIATION, Middletown, Ohio, announces that effective Jan. 1, 1927, the name of the association will be changed to ARMCO CULVERT ASSOCIATION. The change of name does not imply any change in policy, and the association will continue to devote its efforts to research in all matters relating to drainage and irrigation, and to educational publicity for making this research known to those who it will benefit.

AMERICAN BROWN BOVERI ELECTRIC CORP., New York City, announces the following additions to its Camden, N. J., plant personnel: Wilford S. Lowry, formerly with the General Electric Co., at Lynn, Mass., has been assigned to the blower division as an application engineer; J. M. Van Nieukerken, formerly connected with the General Electric, Westinghouse and Cleveland Union Terminals companies at different times, has been appointed a railroad project engineer.

NATIONAL LIME ASSOCIATION announces that its headquarters have been changed to permit expansion of both field and office staffs brought about by the broadening of the association's activities. The new address is 927 15th St., N. W., Washington, D. C.

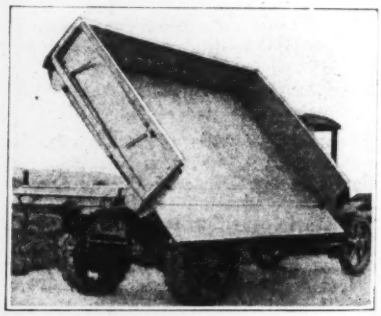
BARBER-GREENE CO., Aurora, Ill., has opened a new office in Kansas City, Mo., at 2045 Main St., in charge of E. H. Cooper.

H. O. PENN, treasurer, Ginsberg-Penn Co., New York machinery distributors, has taken over the interests of Mr. Ginsberg and incorporated a new company to be known as the H. C. Penn Machinery Co., Inc. Mr. Ginsberg has retired to become associated in the general contracting business.

New Developments

Truck Dumps at Either Side or Rear

A steel truck body designed to dump not only to the rear as is usual, but also to either side has been designed by the Differential Steel Car Co., Findlay, Ohio. The side doors are hinged at the bottom and when dumping the door of the low side pulls down into the same



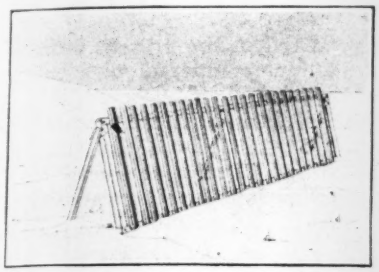
plane as the floor, facilitating the discharge of the material. A system of levers governs the opening and closing of doors.

The hoist for the truck body consists of a telescoping screw driven by a set of bevel gears. Driven clockwise it extends itself, thereby imparting the motion to the body for dumping. Ball and stocket joints at both the top and bottom of the screw allow for extreme flexibility.

All-Metal Snow Fence Built in Sections for Easy Moving

Believing that the old style wood fence has many disadvantages and even blocks the roadway with snow when facing in the wrong direction, the Metal Vane Snow Control Corp., Sioux

Falls, S. D., has designed a portable all-metal snow fence of the type shown in the illustration. The structure is built on the principle of snow stoppage. The wind strikes the faces of the V-shaped vanes or slats, is deflected across the openings between the vanes, and is thus decreased in velocity until it deposits the snow just behind the



fence. The snow is claimed to clear the units and to drift about 2 ft. behind them. For this reason, it is claimed that the fence will never clog.

The fence is built in units 6 ft. high and 12 ft. long, each unit weighing about 70 lb. It is anchored by means of frost pins, the only tools necessary for erection being a wrench and a hammer. The vanes are made of angle-iron A-braces located at both ends and in the middle. The vanes are 3 in. wide and are placed 3 in. apart. The snow fence is made of Armco ingot iron.

A New Flood Lighting Unit for Night Construction Work

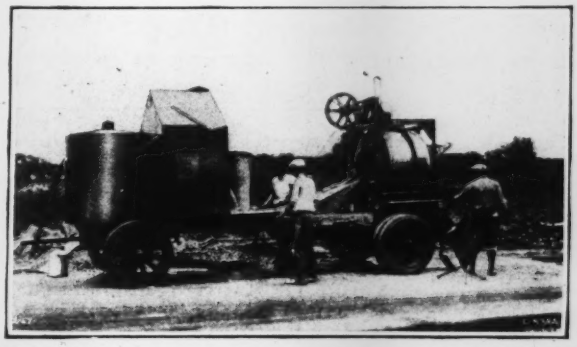
Believing that the ordinary flood light projectors are inefficient because of glare, elongated shadows, and rapid deterioration of the mirrored reflector, the Holophane Glass Co., Inc., 342 Madison Ave., New York City, has developed a special unit for night lighting of construction work. When placed 20 ft. above ground, the unit illuminates a circle of 240 ft. diam.

while raising it to 30 ft. increases the circle diam. to 360 ft.

The metal fixture part of the unit is made of malleable iron, hot dipped galvanized. The glass refractor is locked against an asbestos composition gasket so that the unit is dust-tight. The socket position is adjustable from the exterior of the unit by turning the entire unit about its axis. By raising or lowering the socket, the angle of maximum candlepower can be changed from 65 deg. to 80 deg. The refractor is made in two pieces permanently sealed together. The refracting prisms are on the outside surfaces of the inner element and the diffusing prisms are on the inside surface of the outer element, so that both exposed surfaces are smooth and thus easy to clean.

Trailer Mounted Mixing Plant on Road Repair Work

The illustration shows a Rex mixer manufactured by Chain Belt Co., Milwaukee, Wis., mounted on a special trailer unit which also contains a material bin and water supply. It is being used as a mobile repair unit by the



state highway department of Minnesota near Elk River.

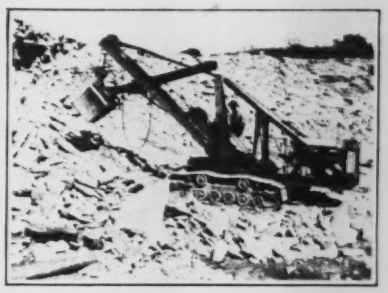
As will be noted, the mixer is so designed and mounted that the charging skip can be let down between the frame of the trailer so that it is on a level with the trailer floor. Aggregate, sand and cement are carried on the truck or else are stored along the highway. The mixer discharges from the end directly onto the pavement being repaired.

Deep Well Pumps Lower Water Table on Irrigation Project

On the Salt River irrigation project in Arizona contamination of surface soil by mineral salts has been overcome by the use of deep-well pumps for subsurface drainage. The soil formation and strata of the Salt River valley are such that the seepage from the river and from the irrigation ditches accumulated and caused a rise in the ground-water table. This brought the mineral salts or alkali near enough to the surface to damage the crops. In order to lower the water table, Worthington Axiflo deep-well pumps have been located at a number of points. Most of them are pumping from depths less than 100 ft. Three capacities of pumps are used—5,000 g.p.m., 4,000 g.p.m. and 3,000 g.p.m. The water table is not now permitted to rise within 10 ft. of the surface.

Fordson Power Shovel for Small Jobs Uses 1/3-Yd. Dipper

The Fundom Hoist & Shovel Co., Lima, Ohio, has designed a new gasoline shovel built around a Fordson power unit, special consideration having been given to reduction in the number of parts and to obtaining a correct balance.

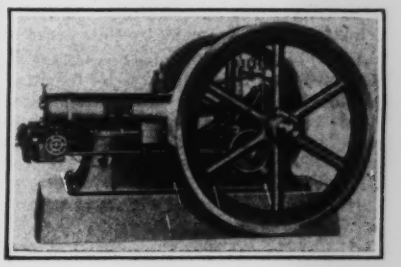


Equipped as shown in the illustration, the machine is mounted on 9½-ft. crawlers, uses a 12-ft. boom of 8-in. channels, and is equipped with a ½-yd. dipper. Provision is made, however, for a boom extension of 11 ft. when it is desired to use the machine for crane, clamshell, dragline or backfill work. A boom and bucket arrangement is also available for hoe-ditcher operation, buckets 18, 24 and 30 in. wide being used.

All bearings are lubricated by Alemite fittings. The crowding mechanism is operated by a lined clutch, driving a link chain around machine-cut pinions on the boom. These pinions mesh with the machine-cut racks on the dipper handle. All high-speed shafts are mounted on roller bearings, and all other bearings have phosphor bronze bushings. The boom travels three-quarters of a circle. The traveling speed of the machine is 3 m.p.h.

New Gasoline Engine for Industrial Use

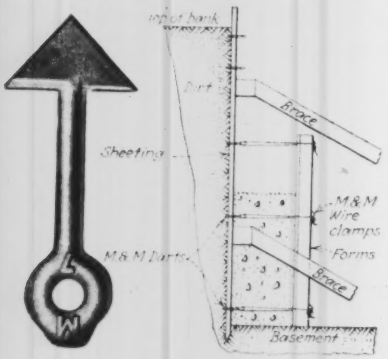
Two gasoline engine models in sizes from 1½ to 12 hp. for lighter work and



20 to 30 hp. for extra heavy work have been developed by the Witte Engine Works, Kansas City, Mo. A number of improvements have been made upon these engines recently, the most important of which include: Removable die-cast bearings; improved valve and water ports in the cylinder head; thin walls in the water hopper aiding ir the radiation and cooling; copper tubing replacing the iron pipe formerly used on the suction gasoline feed; wider and heavier connecting rod covers; improved vaporizing of the fuel by means of improved hot-boxes in the cylinder head.

Ties for Concrete

The forms for outside cellar walls and similar installations often consist of sheathing against the adjacent property and built up wooden forms separated from this sheathing by headers and braces. In order to eliminate these headers and braces, the M. & M. Wire Clamp Co., Minneapolis, Minn., has de-



signed the small darts shown in the illustration. These darts are driven edgeways between the sheathing boards, then turned 90 degrees to a horizontal position so that they cannot be pulled out. Wire fastened to these darts can then be used to hold the inside wall at the forms. The wires are left in the concrete. The illustration shows an example of the use of these darts.

New Publications

Hoists — MUNDY SALES CORP., New York City, has issued a folder describing its new hoist with three-speed transmission. Illustrations and descriptions are included for both the gasoline type and the electric type hoist. Specification tables are given for the gasoline hoists in horsepower ratings from 20 to 75 and for the electric type hoist in horsepowers from 20 to 100.

Arc-Welding Apparatus — GENERAL ELECTRIC CO., Schenectady, N. Y., in a pamphlet dated July, 1926, and numbered GEA-452, describes and illustrates its automatic arc-welding apparatus. The welding head and control equipment are considered in detail as is the operation and wiring diagram for the control panels. Apparatus is given for both straight-seam and circular-seam welding.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Dec. 30, 1926	$12,900,000	$18,719,000	$31,619,000
Dec. 23, 1926	19,081,000	14,930,000	34,011,000
Dec. 31, 1925	8,995,000	10,545,000	19,540,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	1,088,525,000	1,764,122,000	2,852,647,000
1925	1,037,252,000	1,522,191,000	2,559,443,000

Exports Still in Excess of Imports, Particularly in Building Materials

Cement, Steel Pipe, Glass, Boards, Logs, Shingles, Entering U. S.—Brick and Gypsum Not Among Fifty Chief Imports

FOREIGN trade of the United States reached a total of $6,731,580 for the first nine months of 1926, according to the Foreign Commerce Dept. of the Chamber of Commerce of the U. S. This was the largest for that period since 1920, according to the report.

Total exports were $3,409,488, a gain of 3 per cent over imports for the period. Exports showed a loss of 2.7 per cent, compared with the same months last year, while imports amounted to $3,322,092, gained 7.9 per cent.

Despite the apprehensive attitude of American manufacturers with regard to imported building materials, it is found that exports greatly outweigh imports in this phase of foreign trade.

Brick and gypsum plaster are conspicuously absent from the chief imports, while steel, glass and cement represent the three highest on the list in per cent gain over 1925.

Export value of boards, planks and scantlings, which stood twelfth on the list of fifty chief exports, reached $59,798,000 for the first nine months of 1926, against $61,307,000 for the corresponding period last year, a drop of 2.5 per cent. The import values for the same periods were $40,957,000 (1926) and $41,309,000 (1925) respectively, a decline of 0.9 per cent.

Imports of glass and glass products reached a total value of $15,512,000 for the first three-quarters of this year, against $13,084,000 in the same months of 1925, a gain of 18.6 per cent.

Among the fifty chief exports for the period mentioned, were the following, classified as to value:

Materials	First Nine Months 1926	First Nine Months 1925	Per Cent Gain (+) or Loss (—) in 1926 (9 mos.)
Plates, sheets, strips, etc., of iron and steel	$54,698,000	$42,301,000	+29.3
Pipes, tubes and fittings of iron and steel	24,685,000	22,550,000	+ 9.5
Sawed timber	14,351,000	11,694,000	+22.7
Paints, varnishes, etc.	13,762,000	13,485,000	+ 2.4
Construction and conveying machinery	13,260,000	9,297,000	+42.6
Structurals, iron and steel	12,133,000	7,956,000	+52.5
Railway cars, wheels, axles, etc.	11,081,000	11,379,000	— 2.6

Classes of exports for the nine months, showing totals in each below $9,740,000 but above $1,500,000, are as follows: Logs and hewn timber; steel rails; cement, hydraulic; iron and steel bars and rods; petroleum asphalt; iron and steel wire, plain galvanized and barbed; railway track materials, except rails; freight cars; air compressors; locomotives, steam; pumps; doors, wood; and railroad ties.

Groups of imports for the same period, showing totals in each below $12,245,000 but above $1,500,000, follow: Cement, hydraulic; structural shapes and building forms of iron and

steel; steel bars; pipes and tubes of iron and steel; plate glass; lath; logs and timbers; and shingles.

Cement; brick; logs; ship, spar and wharf timbers; clapboards; lath; railroad ties; telephone and telegraph poles are on the tariff free list.

TARIFF RATES ON IMPORTED CONSTRUCTION MATERIALS

Material	Duty
Paint	25% ad valorem
Ornamental tiling	45@60% ad valorem
Lime { common	10c. per 100 lb.
Lime { hydrated	12c. per 100 lb.
Gypsum	$1.40 per ton
Plate glass, unsilvered	12½c.@ 17½c. per sq.ft.
Incandescent light bulbs	20% ad valorem
Stained glass windows	50% ad valorem
Marble, breccia and onyx { in blocks	65c. per cu.ft.
Marble, breccia and onyx { dressed	$1 per cu.ft.
Marble paving tile	8c.@ 13c. per cu.ft.
Marble mosaic cubes	¼c. per lb. plus 20%
Building stone { rough	15c. per cu.ft.
Building stone { polished	50% ad valorem
Slate roofing	15% ad valorem
Iron and steel girders, joists, angles, channels, tees, columns, all structural shapes not assembled	¼c. per lb.
Wire rope	35% ad valorem
Railroad fish plates and tie plates	¼c. per lb.
T-rails	1/16c. per lb.
Cast-iron pipe	20% ad valorem
Wrought-steel pipe	¾c.@ 1¾c. per lb.
Cut nails and spikes	⅛c. per lb.
Rivets	1c. per lb.

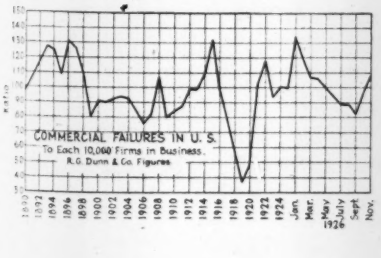
Business Failures Occurring at Normal Rate

The accompanying graph of yearly ratios of commercial failures to each 10,000 business firms, shows two things, namely, that 1926 has conformed to the regular seasonal variation in insolvencies and that current conditions in this respect are very similar to those of 1914, 1898 and 1895.

The chart is drawn from figures compiled by R. G. Dun & Co. and covers commercial defaults only, banking suspensions and personal bankruptcies (farmers, physicians, lawyers, etc.) being excluded.

A normal year is one in which the highest business mortality occurs in January and December, with the seasonal low point in September. The year 1926 has thus far conformed to this rule and will undoubtedly show considerable improvement over 1925.

The extreme low point of the thirty-seven-year period is marked by 1919. At this time and during the first half of 1920, the process of commercial and industrial inflation was in full blast. Then followed the liquidation period of 1921, with excessive materials stocks, falling prices and sharp increase in business failures. The depression actually began in the last half of 1920, causing insolvencies for that year to outnumber those of 1919. Effects of the depression were still being felt in 1922 as shown by the number of defaults occurring in that year.



Quantity Comparison of Imports and Exports of Principal Construction Materials and Equipment During First Nine Months of 1926 and 1925

Imports

Materials	1926	1925	Per Cent Gain (+) or Loss (—) During Period Jan. to Sept., 1926, Inclusive
Cement, hydraulic, lb.	1,045,119,000	915,981,000	+14.1
Structural shapes and building forms of iron and steel, lb.	189,069,000	137,269,000	+37.7
Steel bars, lb.	181,369,000	96,588,000	+87.8
Pipes and tubes of iron and steel, lb.	166,764,000	121,708,000	+37.0
Plate glass, sq.ft.	20,260,000	13,138,000	+54.2
Boards, planks, etc., M.ft. b. m.	1,390,000	1,338,000	+3.9
Lath, thousands	1,466,000	1,559,000	—6.0
Logs and timbers, M.ft. b. m.	124,000	165,000	—24.8
Shingles, thousands	1,893,000	1,889,000	+0.2

Exports

Materials	1926	1925	Per Cent Gain (+) or Loss (—) During Period Jan. to Sept., 1926, Inclusive
Boards, planks and scantlings, lb.	4,723,304,000	4,487,856,000	+5.2
Sawed timber, lb.	1,784,954,000	1,245,239,000	+43.3
Iron and steel plates, etc., lb.	1,417,572,000	1,049,680,000	+35.0
Logs and hewn timber, lb.	523,057,000	375,453,000	+39.3
Pipes, tubes and fittings of iron and steel, lb.	512,825,000	469,901,000	+9.1
Structural iron and steel, lb.	417,516,000	273,048,000	+52.9
Steel rails, lb.	293,014,000	291,935,000	+0.4
Cement, hydraulic, lb.	277,587,000	279,774,000	—0.8
Iron and steel bars and rods, lb.	273,710,000	236,062,000	+15.9
Petroleum asphalt, lb.	221,146,000	120,844,000	+83.0
Iron and steel wire, plain, galv. and barbed, lb.	147,579,000	174,112,000	—15.2
Paints, pigments and varnishes, lb.	125,451,000	125,650,000	—0.2
Railway track material, except rails, lb.	72,644,000	66,211,000	+9.7
Freight cars, number	3,328	3,772	—11.8
Locomotives, steam, number	231	231	0
Air compressors, number	8,006	5,797	+38.1
Pumps, number	90,759	86,392	+5.1
Doors, wood, number	1,193,000	857,000	+39.2
Railway ties, wood, number	2,929,000	2,590,000	+13.1

Railway Construction Requirements 20 Per Cent Ahead of Last Year

Capital expenditures in 1926 on the part of the railroads of the country for equipment, including locomotives and cars, totaled $380,000,000, approximately, according to the American Railway Association. This compares with $338,000,000 for the same purpose last year.

Expenditures for roadway and structures, additional track, heavier rails, additional ballast, shops and engine houses, including machinery and tools, amounted to $495,000,000, against $410,000,000 in 1925.

The railroads of the country have handled this year the heaviest freight traffic in history. This has been accomplished practically without transportation tie-ups, congestion or car shortage.

Cars have been promptly provided and shipments speedy, thus enabling consumers to keep reserve stocks down to a minimum.

Freight loadings for 1926 are estimated at 53,260,000 cars, or about 4 per cent in excess of 1925. The total net ton-miles are estimated at 488,000,000,000, exceeding by 7 per cent the best previous year prior to 1926.

Despite record traffic, few locomotives and freight cars were in need of repairs at any given time. The average load per car is placed at 27.2 tons, or heavier than that for 1925 or the year preceding.

Freight movements were quicker in 1926 than in any preceding year, owing to faster loading and unloading of cars and elimination of other delays in handling. Efforts are being made by the railroads to educate shippers to the necessity for loading cars more nearly to capacity.

Special Tabulation of Unit Prices
Steel Reinforcing Bars

The following unit prices are included in the low bidders' estimates on various jobs throughout the country, 1922 to date:

Project	Date	Lb.	Price per Lb.
Power house, Cohoes, N. Y.	Aug. 1922	470,000	$0.055
Tunnel, Providence, R. I.	Aug. 1922	150,000	.05
Tunnel, Newark, N. J.	Oct. 1922	48,000	.06
Viaduct, St. Louis, Mo.	June 1923	2,025,000	.055
Pipe line, Hetch Hetchy Project, Calif.	July 1923	8,000	.10
Approach piers, Delaware River bridge, Philadelphia, Pa.	Feb. 1924	45,600	.05
Anchorages, Philadelphia, Pa.	June 1924	20,000	.05
Viaduct, Philadelphia, Pa.	July 1924	450,000	.05
Grade separation, Detroit, Mich.	Oct. 1924	170,800	.05
Tunnel, Washington, D. C.	Nov. 1924	3,900	.07
Drain, Silver Creek, Grand Rapids, Mich.	Nov. 1924	20,000	.05
Tunnel, Jersey City, N. J.	Mar. 1925	770,000	.10
Inspection shed inclosures, New York, N. Y.	Apr. 1925	80,000	.05
Re-location, of Erie R.R., Wanaque, N. J.	May 1925	100,000	.06
Excavating, grading, etc., White Plains, N. Y.	Oct. 1925	5,000	.06
Tunnel ventilation buildings, New York, N. Y.	Oct. 1925	120,000	.06
Viaduct, Jersey City, N. J.	Mar. 1926	710,000	.055
Grade crossing elimination, Warren, O.	July 1926	1,600,400	.05
Viaduct, Newark, N. J.	July 1926	260,000	.06
Drain, Grand Rapids, Mich.	July 1926	20,000	.05

Weekly Construction Market

FIRMNESS, with little tendency to fluctuate, characterizes the present market in basic building materials.

Reports received by *Engineering News-Record* from the eight great industrial districts of the country, indicate a continuation of the recent trend toward price stability, with no shortage of materials despite growing demand for winter construction and inclement weather.

Commodities other than those used in construction show firmer tendencies, with advances considerably in excess of declines. A year ago the opposite condition prevailed in the general wholesale markets.

Few strikes prevail in the construction industry at the present time and no serious controveries are in prospect.

The volume of work still in the proposed stage indicates a continuation of building materials consumption at somewhere near the present rate.

Considerable structural steel tonnage is in prospect. Demand is active and prices firm in railway material, steel plates, rails, lap-weld steel pipe and cast-iron pipe. The pig-iron market is slow with buying confined to small tonnages in the South and West; the North-Atlantic states, however, show livelier interest in this basic material, which governs the price of structural steel.

Linseed oil continues to decline, with reductions of 40c. per gal. reported in mixed paint. No further recessions in paint prices are anticipated; the probabilities are that the next change will be in upward direction.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.30	3.15	$4.00
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	3.25	2.30@2.50	2.87½	3.77½	2.95	3.10	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	54.25%	41%	+42@53.8%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	50.60	42.75	56.00	47.20	53.00	64.00	49.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1 15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.85	1.65	1.90	1.80	1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.65	1.25	1.00	1.40	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	40.50	38.75	34.75	27.00	25.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3 00	1.50	1.82	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10 50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	0895	.112	088	076	075	.....	09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	088	076	.075	108	09	08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	—.81	90¾	—1.10	.84	.92¼	1.06	.98	1.12	1 05
Common Labor									
Common labor, union, hour	90¾	30		90		50@.55	.55	62½	
Common labor, non-union, hour		25	30@.50	....	45@.60	40@.45	50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.
Labor—Cement and concrete laborers' rate, $1.06½; building laborers, 90¾c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Dec. 2 the next on Jan. 6.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.92). Bag charge is 80c. per bbl. Discount of 10c per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 5½ per cent, Dec. 27; year ago, 6 per cent.

Time loans: 60 to 90 days, 4½; 4 to 6 months, 4⅝@4¾ per cent.

Commercial paper: Best names, 4@6 mo., 4½; others, 4¾ per cent.

On Dec. 1, 1926

E. N.-R. Construction Cost Index Number 210.80

E. N.-R. Construction Volume Index Number 211

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month